Pend Oreille River Temperature TMDL

TMDL History 2004 - 2006

- **2004 - 2007** EPA, Kalispel Tribe, States of Washington and Idaho collaborate on TMDL
- **May 2004 –**MOA between States, Tribe and EPA signed
- **2005** EPA awarded a $15,000 grant to the Tribe for water quality modeling and an independent review of the CEQualW2 water quality model. The Tribe returned the model review funds to EPA ($8000.00), indicating in their final performance report that "The Tribe has been an active participant through the modeling of all portions of the Pend Oreille River and throughout the TMDL process and no longer feels that a third party review of the respective models to be applicable or necessary."
- **2006** EPA established a $90,000 contract with Tetra Tech to develop hydrologic and temperature models of Calispell Creek at the request of the Tribe.

TMDL History 2007 - 2011

- **July 2007** Draft Interjurisdictional TMDL shared with stakeholders
- **July 2007 – December 2009**
  - States address stakeholder comments on TMDL
  - EPA - Ecology discourse on WQS interpretation
  - Washington moves forward with TMDL using CFA
- **January 2009** - **August 2010** - Two staff meetings between EPA & Kalispel Tribe
- **Fall 2010** – Draft Washington TMDL out for public comment
- **January 2011** Third staff meeting between EPA and Kalispel Tribe
- **Spring 2011** EPA letter to Kalispel Tribe offering consultation; Tribe requests consultation

TMDL History 2011

- **April 2011** Ecology submits TMDL to EPA; Dam operators request dispute resolution & file lawsuits
- **Summer 2011** Consultation between RA & Tribal Chairman at reservation, followed by RA letter
- **August 2011** Dispute Resolution Process results in changes to TMDL; EPA successfully requests edits responsive to issues raised by Tribe
- **November 2011** Ecology submits final TMDL; Fourth Meeting between EPA & Tribal staff

TMDL History 2011-2012

- **February 2011** Phone conversation and follow up letter from Office of Water Director, Mike Bussell to Deane Osterman at Kalispel Tribe Natural Resources Department
- **March 2012** – Tribe sends FOIA request and letter reiterating issues with TMDL
- **June 2012** – Second FOIA from Tribe and appeal of first FOIA
- **July 2012** – Meeting between HQ and Tribe

2004 Pend Oreille River TMDL MOA

- "Because the Washington portion of the Pend Oreille River abuts Kalispel Tribal waters, and these waters are impaired for temperature and TDG under the Kalispel Tribe's water quality standards, EPA is the lead on a TMDL to address impairment to Tribal waters in the Pend Oreille River."
- We have asked the Tribe if they want us to issue a TMDL for Tribal waters and they were not interested

- "All parties agree that a single multi-jurisdictional TMDL is necessary to address temperature impairment"
- Though the entities signing the MOA felt collaboration was desirable, the MOA was not a binding agreement, and all parties understood this
- The collaboration that occurred under the MOA was invaluable to all parties – building models that are based on consistent assumptions and data, forming a strong technical basis for the TMDL and also resulting in facilitated meetings between stakeholders

Partial Attainment of 2005 MOA

- The Tribe contends “the collaborative, river-wide approach crumbled under pressure from the regulated community regarding the effect of alleged time lags on the TMDL”
- This implies that Ecology did not make any difficult decisions against the interests of the dam operators
- Actually Ecology rejected vertical (volume) averaging of temperatures in the impoundment and interpreted standards against the views of the dam operators
- The dam operators were not pleased with the TMDL – initiating dispute resolution and lawsuits upon its issuance
- The MOA was only partially completed (no interjurisdictional TMDL) due to a loss of funding in Idaho and this dispute between Ecology and the Tribe

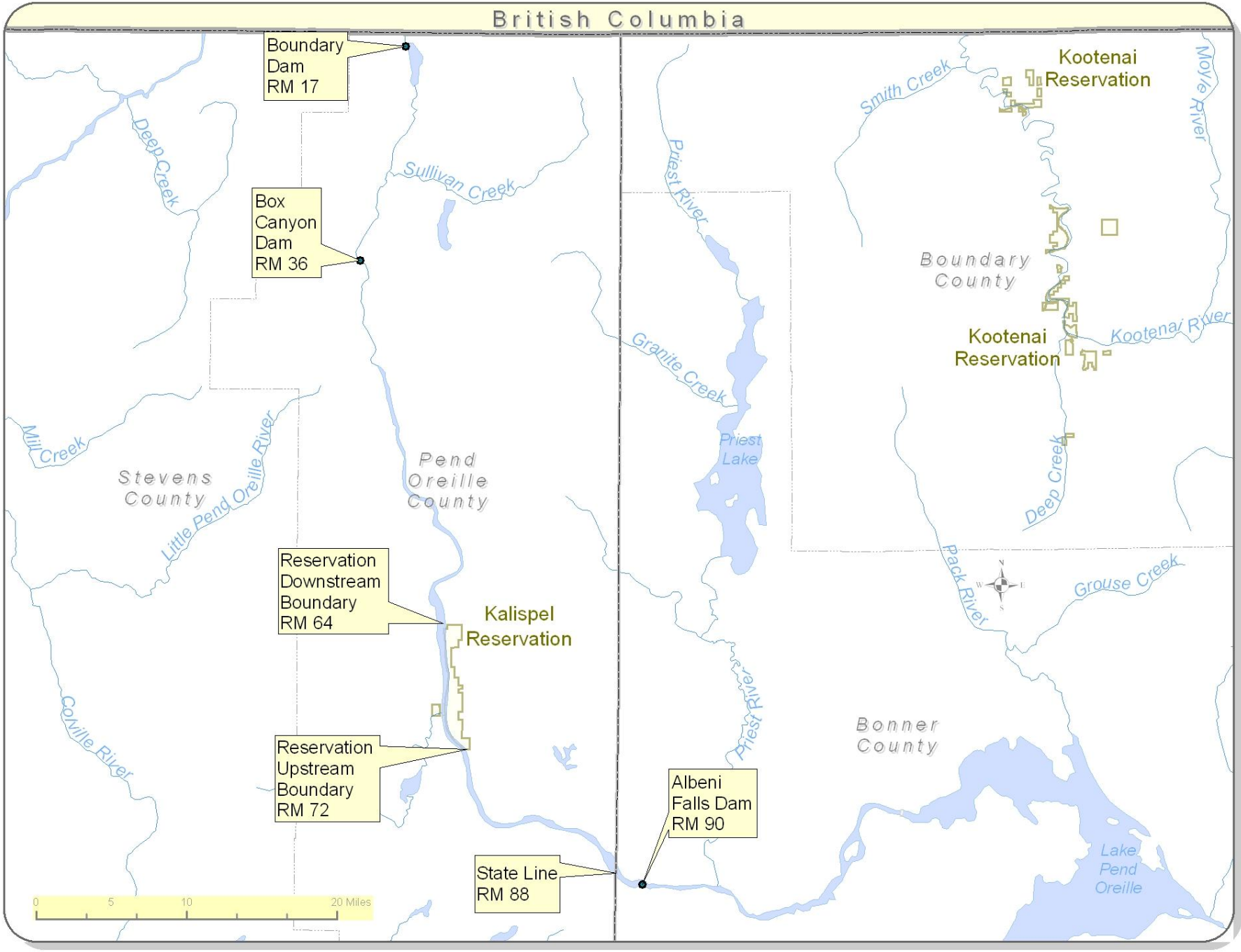
Partial Attainment of 2005 MOA

- "EPA helped the regulated community push its agenda but did not seek to promote the Tribe's sovereign prerogatives as required by the MOA"
- Baseless statement asserts an EPA intent where there was none.
- May refer to 2007 email Ben Cope and SCL's contractor wrote clarifying the strengths & weaknesses of CFA methodology (This email occurred before Ecology decided to use CFA in the TMDL and before the Tribe had stated concerns about CFA)
- EPA Supported Tribe's interests with regard to TMDL:
  - provided the Tribe with $105,000 in grant and contract funding for work related to the TMDL
  - Negotiated for over a year with Ecology to reverse a Pend Oreille River standards interpretation that was opposed by the Tribe
  - Successfully intervened on proposed changes to TMDL from dispute resolution process in response to Tribe's comments

Partial Attainment of 2005 MOA

- “EPA then managed the Tribe as a State-problem”
- There have actually been two major issues between the tribe and Ecology in this TMDL. EPA has sided with the tribe on one major issue (WQS interpretation) and with Ecology on the other (model output analysis). There is no bias here, just disagreement on what is reasonable and what is not.

- “The Tribe has consistently voiced opposition to the resulting fragmented approach to the temperature problem on the Pend Oreille River and incorporation of the polluters’ preferred methodology into the TMDL”
- Both the Tribe and state have been consistent in their disagreement over this issue. The “polluters” (dam operators) do not prefer all aspects of the TMDL, as noted earlier


British Columbia
Boundary Dam RM 17
Box Canyon Dam RM 36
Reservation Downstream Boundary RM 64
Kalispel Reservation
Reservation Upstream Boundary RM 72
State Line RM 88
Albeni Falls Dam RM 90
Kootenai Reservation
Kootenai Reservation
Deep Creek
Sullivan Creek
Mill Creek
Little Pend Oreille River
Colville River
Stevens County
Pend Oreille County
Priest River
Granite Creek
Priest Lake
Priest River
Smith Creek
Moyie River
Boundary County
Kootenai River
Deep Creek
Pack River
Grouse Creek
Bonner County
Lake Pend Oreille
0 5 10 20 Miles

What Does the Tribe Want?

- Tribe has represented that they are satisfied with measures at Boundary and Box Canyon Dams
- Because of location – Boundary Dam does not have temperature effects on reservation waters
- Box Canyon Dam– Tribe is satisfied with measures
- Primary Issue: Albeni Falls Dam and determination of heat loading at state line
- Interest in using the TMDL to leverage discussions with the Corps re: Albeni Falls Dam

Kalispel Tribe Support from Dam Operators

- Seattle City Light (Boundary Dam)
- 4/09 - Under the FERC license Pend Oreille PUD (Box Canyon Dam) will spend $250 million for restoration and mitigation including
  - Spend more than $50 million on a fish passage facility. It must remove nonnative fish and reintroduce desirable trout species.
  - Restore trout habitat on 164 miles of rivers and streams that flow into the Pend Oreille River over the next 25 years.
  - Develop a plan to improve recreation facilities on the reservoir, and provide money for the tribe to build recreation facilities at the Pow Wow Grounds, Kalispel Boat Launch and Manresa Grotto Beach.

- 7/ 2012 - $39.5 million - 10 year agreement with BPA, USBR & USACE focused on actions to address impacts of Albeni Falls Dam on fish and wildlife

Tribe's Objections to CFA

- Cannot be used to determine compliance with daily maximum water quality standard that are part of the State and Tribal WQS
- Masks the quantity and magnitude of temperature exceedences, in particular at the Idaho border and in Tribal waters
- It is being used in a technically inappropriate way
  - Only appropriate to use where data are random and not interdependent
  - Excessive pooling periods should not be used for short term time lag effects
- Is unacceptable for meeting the Kalispel standards in Tribe's waters
  - Violates Tribe's sovereignty
  - Does not meet downstream waters standards
- Is applied for non scientific reasons - benefit polluters

Daily Comparison Method

- The model divides the river into segments along its length
- Data generated for each segment on half hour intervals for 2004 and 2005
- There are two (relevant) model runs
  - a Natural Conditions simulation without the dams
  - an Existing Conditions simulation
- Each simulation has data for every segment and every half hour over the two years modeled
- Daily Comparison Method compares the maximum daily temperature from the Existing Conditions simulation to data from the same time and location in the Natural Conditions simulation – the difference is the magnitude of impairment

What the Tribe said about Daily Comparison

- It is the only method of model data analysis that can be used to determine compliance with their WQS
- It is the only method that can be used to determine compliance with a daily maximum WQS
- It is the only method that accurately determines the magnitude of temperature impairment from human activities in the Pend Oreille

What the Tribe left out about Daily Comparison

- No TMDLs in R10 have used Daily Comparison with 2 dimensional models
- This type of analysis does not eliminate time lag effects that arise from the changes in stream velocity between dams in place and no dam model simulations
- This is a very conservative analysis method that does not take into account the uncertainty inherent in complex models
- This focus on “violations” rather than exceedance of loading capacity does not address the requirements of a TMDL, namely setting allocations with a linkage to human activities

Advantages of Daily Comparison

- Simple to explain and understand
- Extensively used with one dimensional modeling and data analysis for TMDLs
- Conservative – high MOS

Drawbacks to Daily Comparison

- Overly conservative when used with a two dimensional model – model data are estimates with uncertainties. This is one reason model results are often aggregated over time and space to provide a more generalized estimate with greater confidence
- Not capable of eliminating or reducing time lag effects that occur in rivers with dams

Daily Comparison Method Discussion

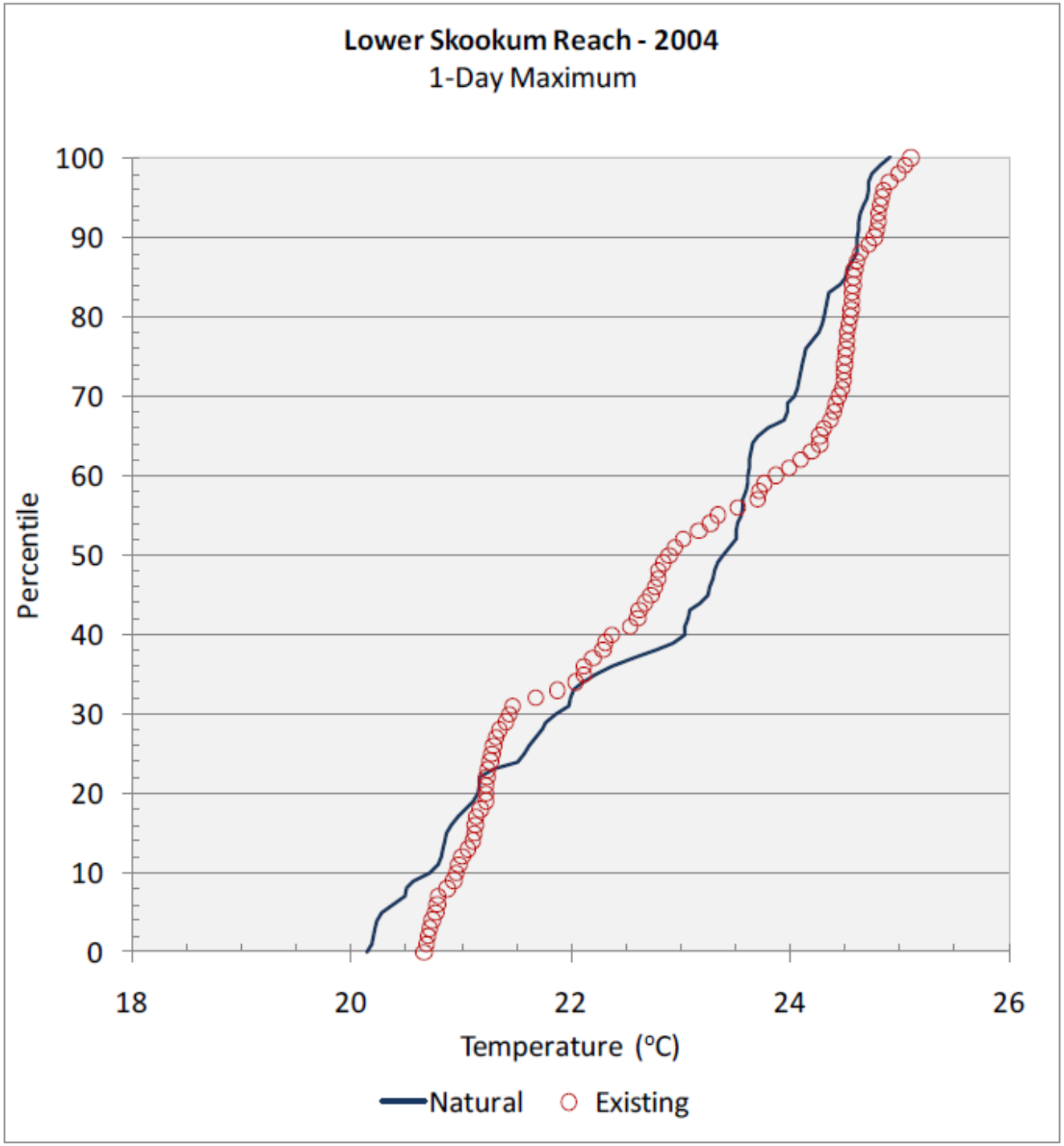
- Tribe believes Daily Comparison is the only method to accurately determine magnitude and frequency of water quality violations
- Frequency of violations was not used to set allocations in the TMDL, only magnitude
- Many methods of data analysis exist and are used to set TMDL allocations. Limiting an area to only one is overly restrictive and there is nothing about the Pend Oreille River that would warrant such a restriction.

Cumulative Frequency Analysis

- CFA is a statistical analysis of two data sets
- Data distributions are compared at each rank percentile value (frequency of occurrence in the data pool)
- One cannot do a cumulative frequency analysis without first aggregating (pooling) the data

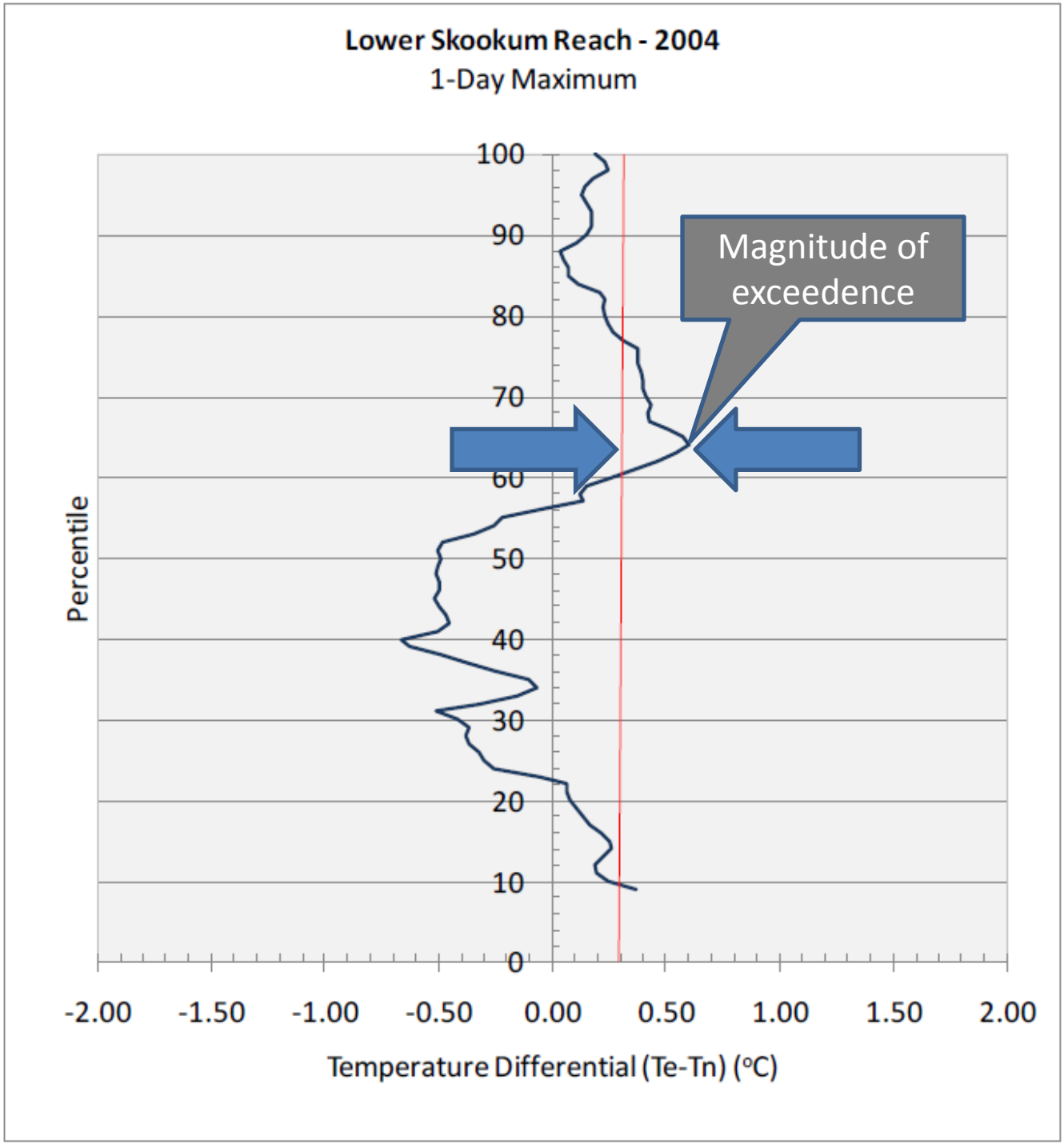
CFA in TMDL

- The daily maximum data points in the existing conditions simulation that exceed each criteria were pooled (about 62 days)
- The corresponding data points (same location, same time) in the natural conditions simulation were also pooled
- These pools of data were then plotted by cumulative frequency of occurrence in the data set


Lower Skookum Reach - 2004
1-Day Maximum
Percentile
100
90
80
70
60
50
40
30
20
10
0
18
20
22
24
26
Temperature (°C)
Natural
Existing

CFA in TMDL

- Once the two sets of data were plotted by cumulative frequency of occurrence, data points of the same rank in each data set were subtracted from each other.
- This difference was then plotted on the same vertical (frequency of occurrence) axis
- The vertical center line is zero difference
- The red line is the 0.3 C human use allowance in the state's natural conditions criteria

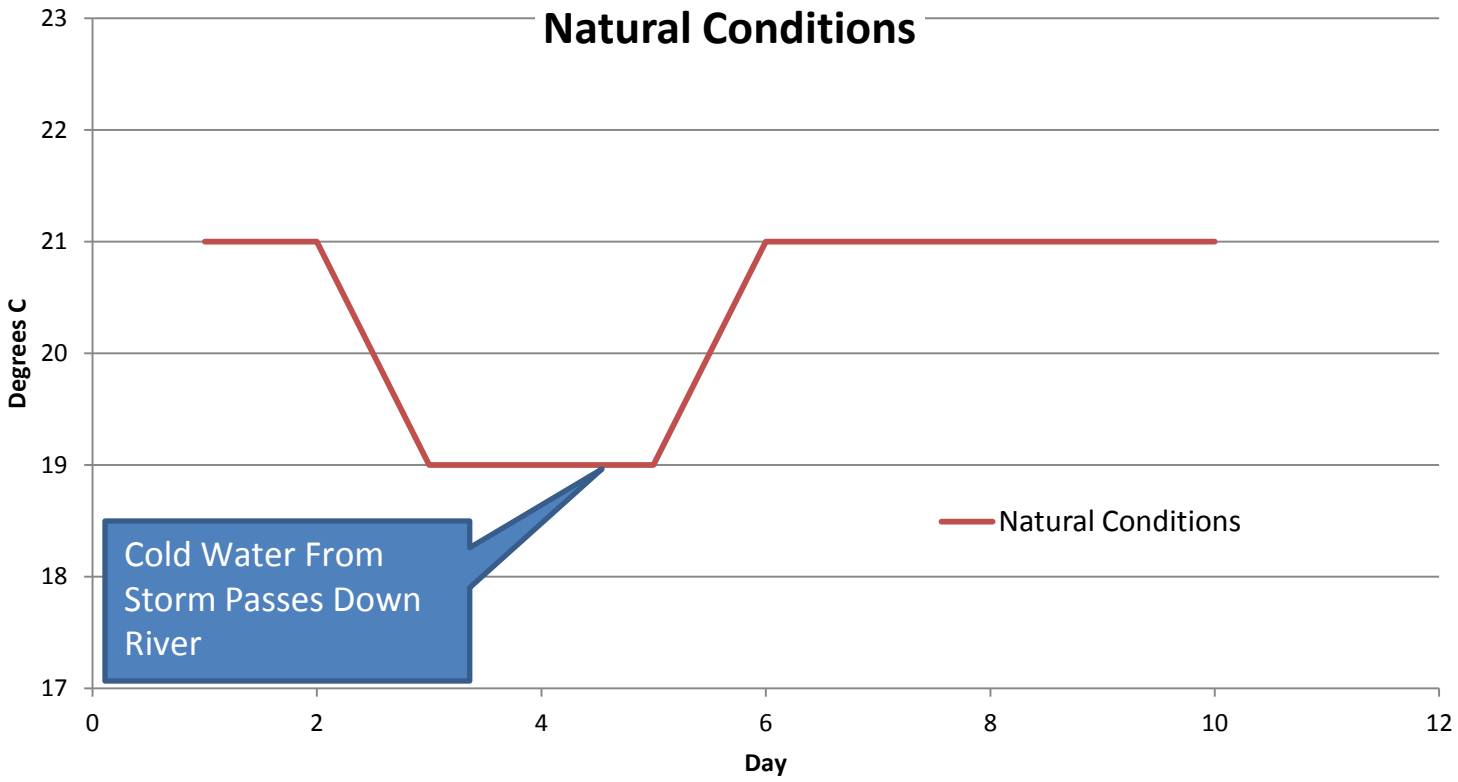

Lower Skookum Reach - 2004
1-Day Maximum
Magnitude of exceedence
Percentile
100
90
80
70
60
50
40
30
20
10
0
-2.00
-1.50
-1.00
-0.50
0.00
0.50
1.00
1.50
2.00
Temperature Differential (Te-Tn) (°C)

Time Lag

- Dams slow the travel time of water downstream
- In model simulations with dams in place (existing conditions) the same pulse of water will pass a location later than it will in the undammed (natural conditions) scenario.
- Comparing data points from the same time and place between the two model simulations can result in an brief exceedence of the criteria due to a cool pulse of water moving downstream

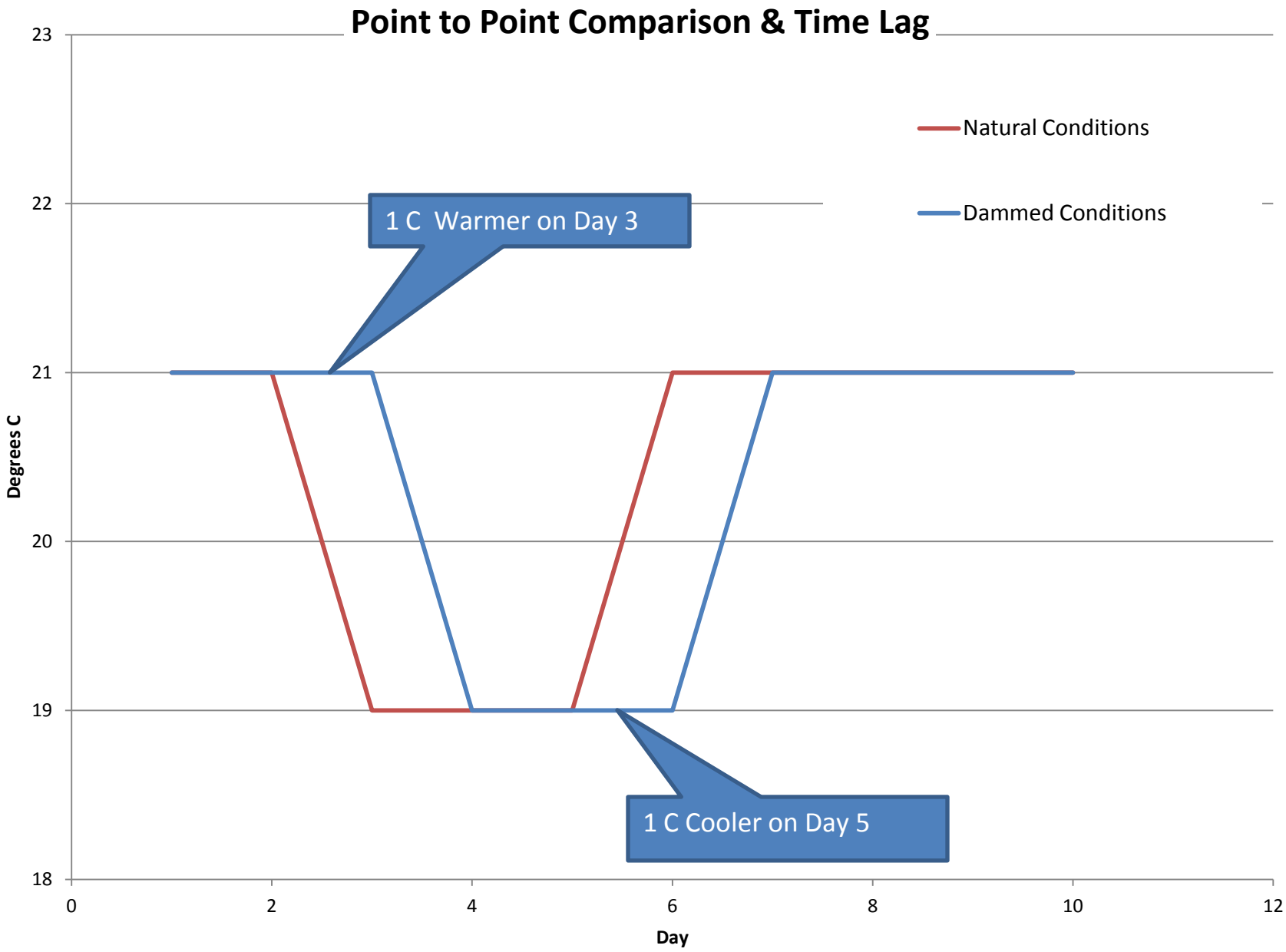
Time Lag

- If there is a storm upstream in the mountains a pulse of cool water will flow down the river



Time Lag

- Comparing model data from the same time and location between the “natural conditions” and “dams in place” model simulations, will show a brief exceedence caused by weather and differing flow velocities


Point to Point Comparison & Time Lag
Natural Conditions
Dammed Conditions
1 C Warmer on Day 3
1 C Cooler on Day 5
Degrees C
Day
23
22
21
20
19
18
0
2
4
6
8
10
12

CFA in the TMDL

- Ecology changed the model data analysis method from daily comparison to CFA for these reasons:
  - CFA allowed for the comparison of different hydrologic conditions by minimizing differences in volume and flow as a result of hydroelectric facility operation
  - CFA minimized the effect of short-term events such as weather fronts
  - CFA provided a way to determine how often temperatures of a given magnitude occur within a specific amount of time

Tribe said about CFA

- CFA must only be used with random, independent data sets and has been used inappropriately in the TMDL
- “CFA does not comport with the temporal requirements of Kalispel or State water quality standards”
- CFA “masks the frequency and magnitude of Kalispel water quality violations, as well as upstream contributions to those violations”
- “The selected remedy for the [time] lag (93-day CFA) is grossly disproportionate to a time lag that is on the order of days according to Ecology, and at most 1 day on tribal waters”

What the Tribe left out about CFA

- It is a refined tool that can be helpful in complicated modeling situations such as the Pend Oreille River or the Willamette River
- The use of CFA instead of a simpler and more commonly used method, such as volume weighted averaging, resulted in much higher allocations in the TMDL
- Each of the Tribe's issues with the use of CFA in the TMDL will be addressed in the presentation

Advantages and Drawbacks of CFA

- Advantages
  - Can be used to analyze data where there is a temporal lag, and where spatial averaging would mask impairment
  - Accepted method of analysis
- Drawbacks
  - Difficult to explain and not intuitive
  - Not applicable in all situations. Must, like all modeling tools, be chosen to meet the specific needs of the situation

CFA Discussion

- "Based on input from the regulated community, Ecology decided to employ a seasonal CFA to determine compliance with state and tribal water quality criteria"
- **Ecology also consulted with EPA and looked to the Willamette TMDL in Oregon**
- "Using a sophisticated model…Ecology determined maximum temperatures at a given point in the river for each day under existing and natural conditions"
- **Temperatures are estimated, not determined, from a model. There are uncertainties in these estimates, and this is one reason model results are often aggregated over time and space to provide a more generalized estimate with greater confidence.**

CFA Discussion

- "Ecology then disassociated maximum existing and natural temperatures from the dates on which they occurred"
- **Correct, that's a necessary step for CFA**
- "Resulting data provides seasonal impairment information that bears no relationship to State and Kalispel water quality standards"
- **The standards are silent on how to aggregate temperature data that exceed the numeric criterion in order to set a TMDL allocation.**
- **TMDLs commonly set allocations for time frames of bi-weekly, monthly, seasonal, or annual. There are no TMDLs in Region 10 that establish single-day allocations as the tribe's method would require.**

Why R10 believes CFA is Acceptable

- **States have discretion in their choice of technical analysis methods**
- **EPA's review of CFA use in the TMDL did not find any evidence that the method conflicts with the applicable water quality standards or biases the results.**
- **Previous TMDLs approved by EPA in the Northwest have used similar data aggregation and CFA methods (e.g., Willamette)**
- **There is nothing in the Tribe's WQS wording that would preclude the use of CFA to determine whether their WQS were being met at the Reservation boundary, in fact Ecology used more conservative assumptions in their analysis than the wording of the Tribe's WQS requires.**
- **Despite requests from EPA, the Tribe has not produced instances where CFA would result in a specific negative impact on biota. To be compelling, an impact would need to be identified that is specific to a species, life stage, and calendar date, consistent with the Tribe's insistence on day-by-day impact assessment.**

CFA and Daily Maximum Criteria

- "The function of a 1-DMax standard is to ensure that a particular temperature threshold is not exceeded over a 24-hour period"
- "CFA fails to preserve the relationship between thermal threshold and time of exposure"
  - The purpose of a seasonal CFA is to evaluate whether "projects or scenarios ha[ve] an *overall impact on the river instead of just a day to day impact*"
- **The 20 C daily maximum criterion is exceeded throughout the summer. The "thermal threshold" is already exceeded. Not clear what is meant by the "time of exposure" (calendar date?).**
- **It is reasonable to assess for the overall (longer period) impact since TMDL allocations are established for time frames ranging from weeks to seasons.**
- **To clarify, the allocations in this TMDL are not "seasonal" but rather are set for July-August. The standards can be read to apply to the "season" when temperatures exceed the criterion values.**

CFA and Daily Maximum Criteria

- "Ecology's application of CFA to determine compliance with the Tribe's criteria is wrong, results in harm to the Tribe, and undermines tribal sovereignty"
- **The TMDL applies the same methodology to state and tribal waters, so there is no bias against protection of tribal waters.**
- **If EPA sided with the tribe and rejected the state's interpretation of its standards, the state would claim harm and loss of sovereignty.**
- **EPA has not been able to satisfy both parties.**

Points to Consider

- Model data is a tool for assessment, not a exact representation of river conditions; Data points in a model are estimations that have uncertainty
- Natural causes are excluded from these criteria by the wording of the standards and CFA was used to limit effects of natural conditions
- Ancillary considerations:
  - Beneficial use effects
  - Limited applicability of daily max criteria in the analysis

Washington's 20 C Daily Maximum Criterion

- Temperature shall not exceed a 1-day maximum (1-DMax) of 20°C due to human activities.
- When natural conditions exceed a 1-DMax of 20°C, no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C;
- WAC 173-201A-200

Difference in Results - CFA vs Daily Comparison

- Review of model data from 8 of the 12 modeled reaches (Box Canyon Forebay – Stateline) in WA for 2004 & 2005 using Daily Comparison
- Daily maximum water temperature exceeded 20 C 1,147 times in the model data
- In 39 of these instances the natural conditions simulation was below 20 C and the daily maximum criteria applied (3.4% of cases)

Daily Maximum Criteria Exceedences

- The CFA analysis method showed no exceedences over the 1.13 C Box Canyon Load Allocation
- For the Daily Comparison there were 8 instances where the exceedence was greater than the Load Allocation
  - The average of the excess over the load allocation was 0.24 C
  - maximum exceedence 1.15 degrees C over the load allocation

Natural Effects on Temperature Variation

- Ecology selected CFA analysis of the model data to remove instances where natural effects caused short fluctuations in temperature that show up as exceedences of the criteria.
- Washington's daily maximum criterion has a clause specifying only exceedences due to human activities are considered

Washington's 20 C Daily Maximum Criteria

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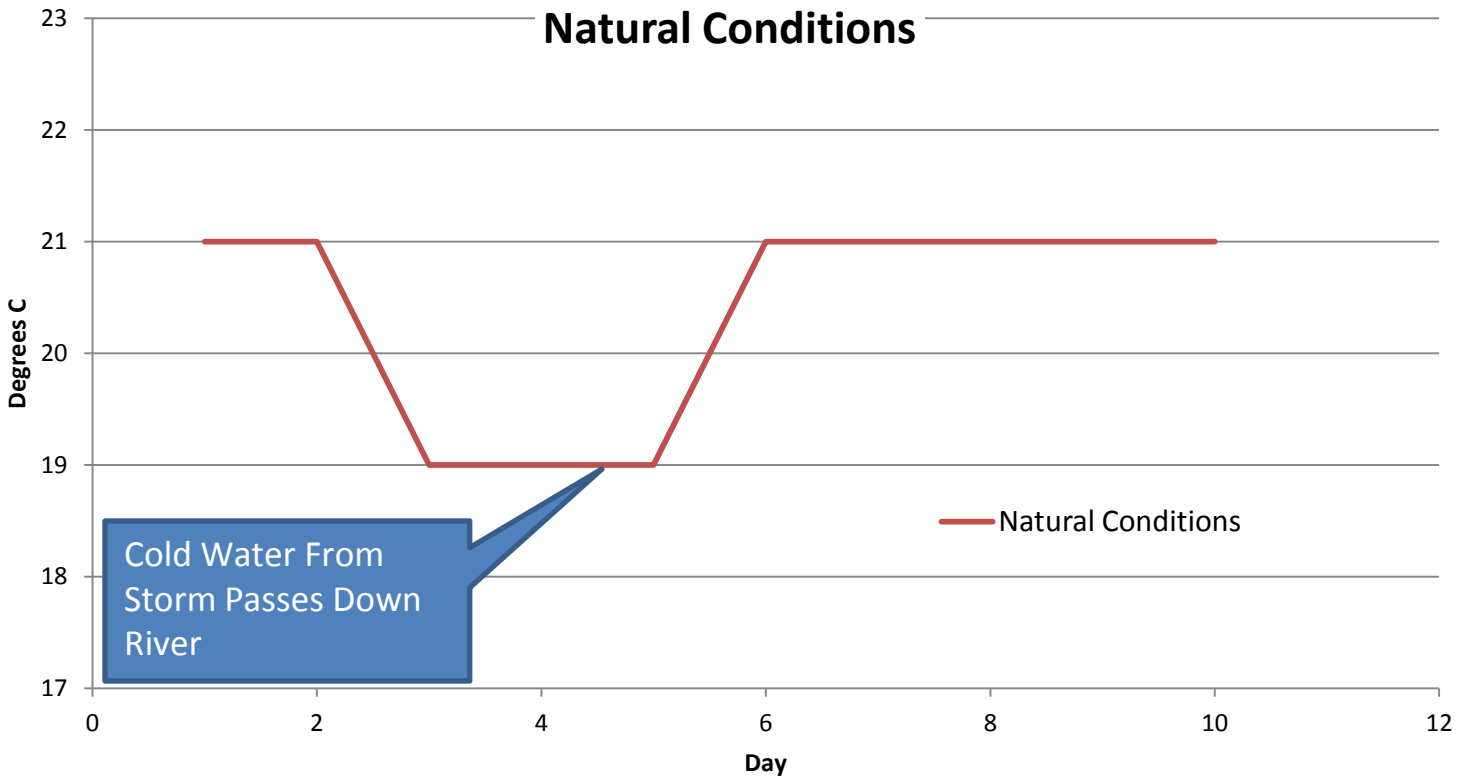

Time Lag

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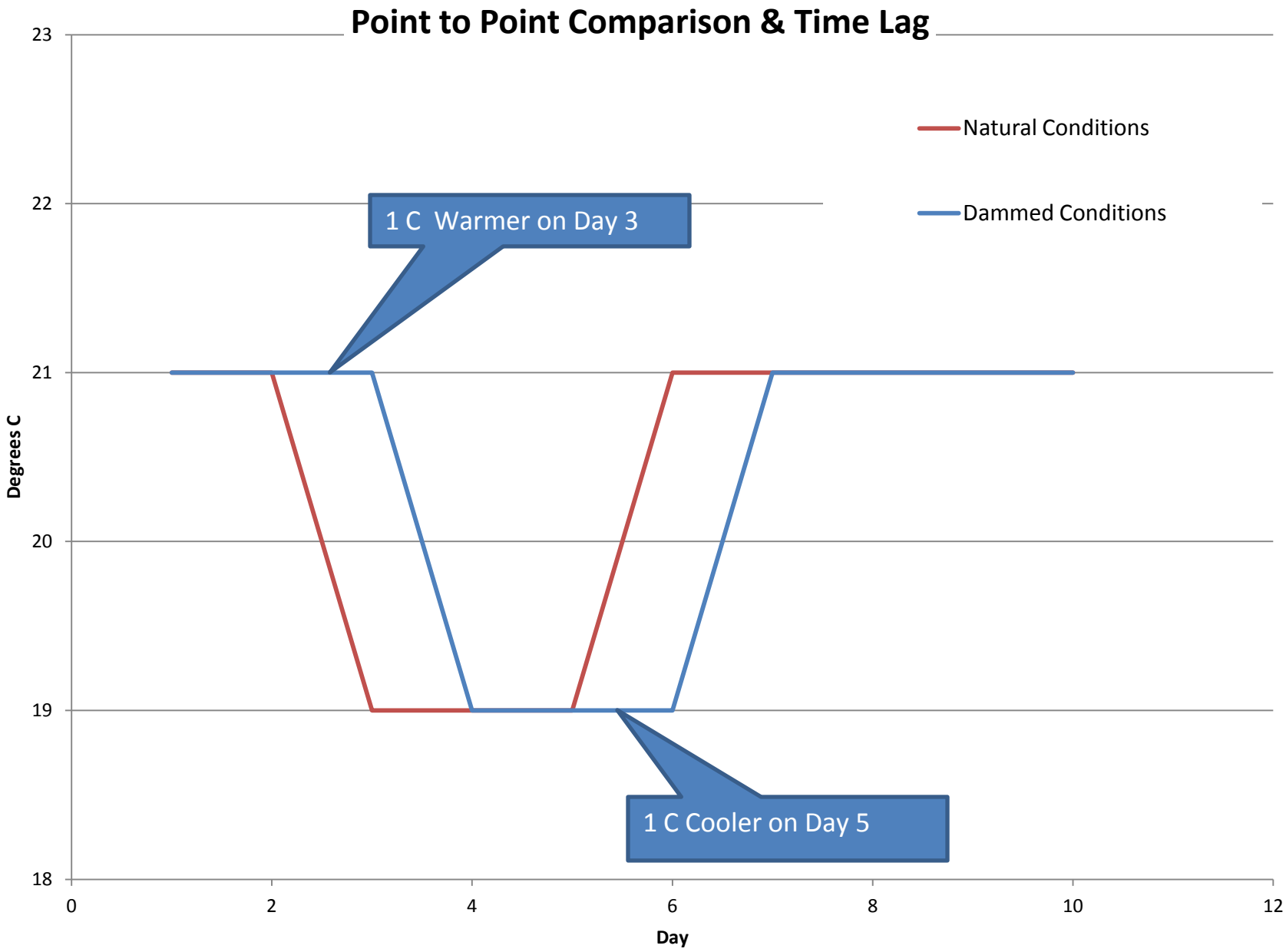
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1 C Warmer on Day 3
1 C Cooler on Day 5
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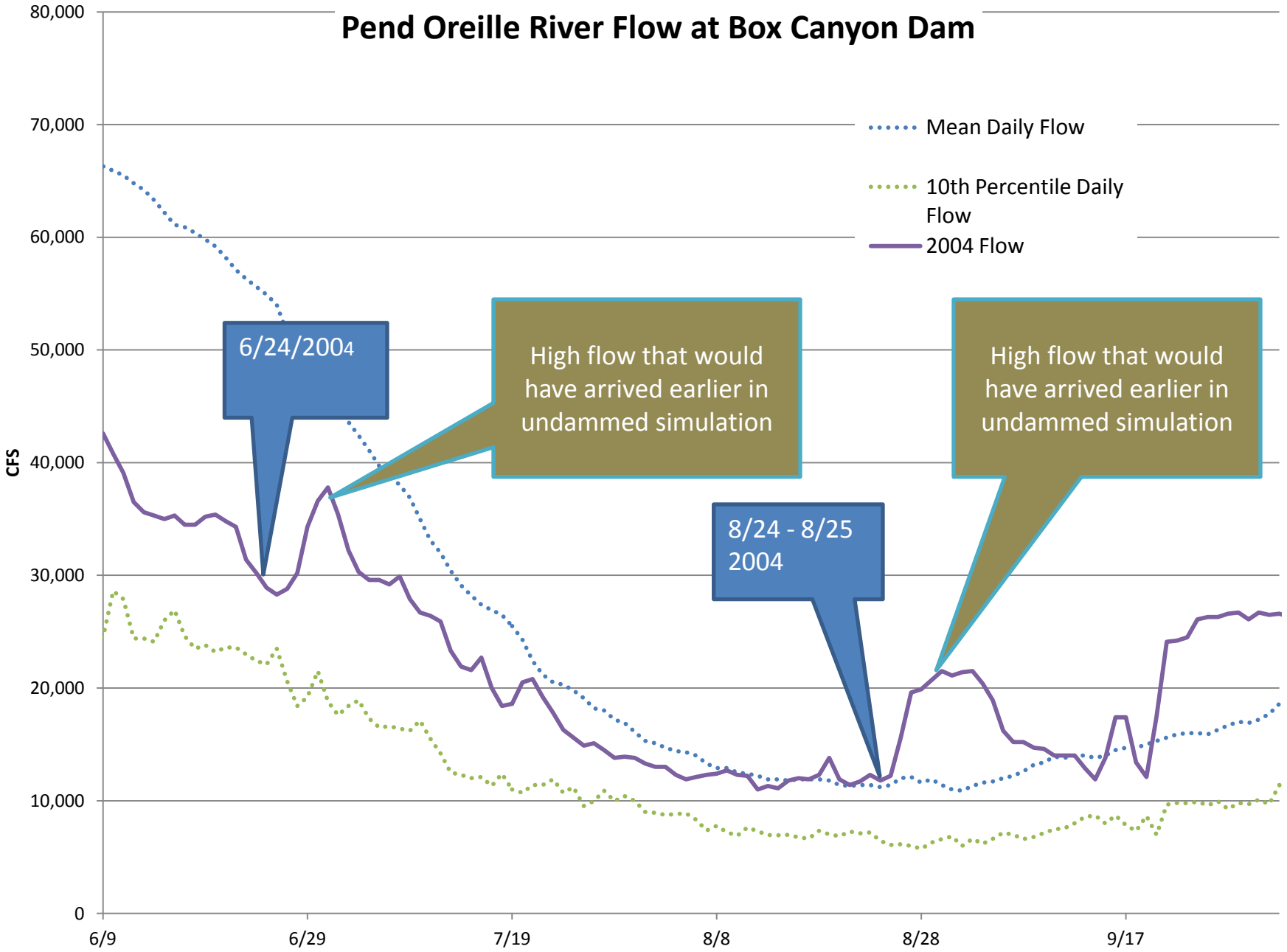
Natural Effects & Time Lag

- Ecology used CFA analysis to exclude the time lag effects described above, which were not pertinent to the analysis because they were the result of natural weather events
- Evaluate whether the Daily Comparison exceedences resulted from time lag using:
  - Flow Data
  - Weather Data
  - Plots of the model data

Flow Data

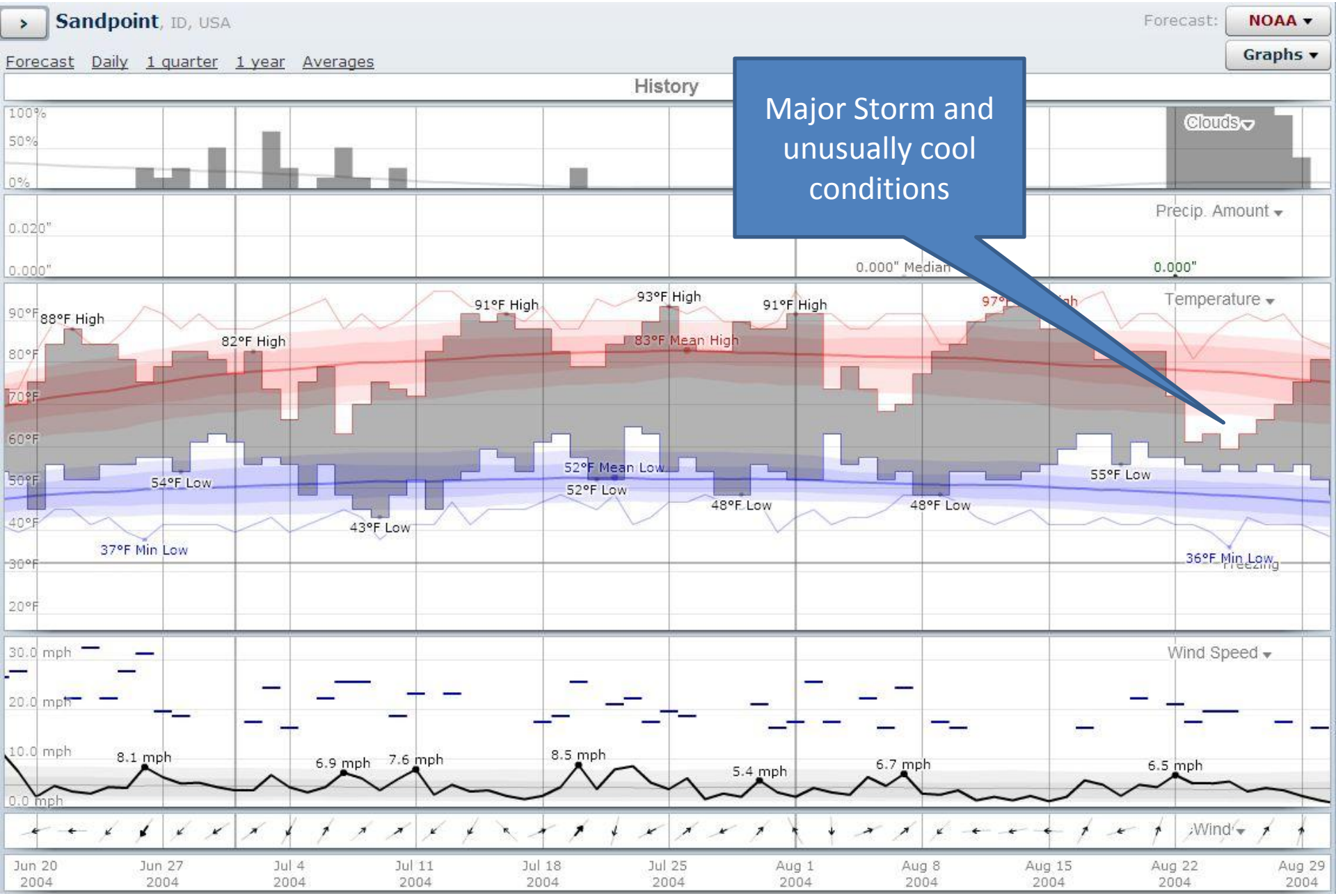
- The Daily Comparison model analysis exceedences above the Load Allocation occur
  - June 24, 2004
  - June 30 – July 1, 2004
  - August 24 – 25, 2004

  The first and last dates immediately precede a large increase in flow in the river that would have cooled stream temperatures and reached the same location earlier than in the undammed simulation


Pend Oreille River Flow at Box Canyon Dam
Mean Daily Flow
10th Percentile Daily Flow
2004 Flow
CFS
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
6/9
6/29
7/19
8/8
8/28
9/17
6/24/2004
High flow that would have arrived earlier in undammed simulation
8/24 - 8/25 2004
High flow that would have arrived earlier in undammed simulation

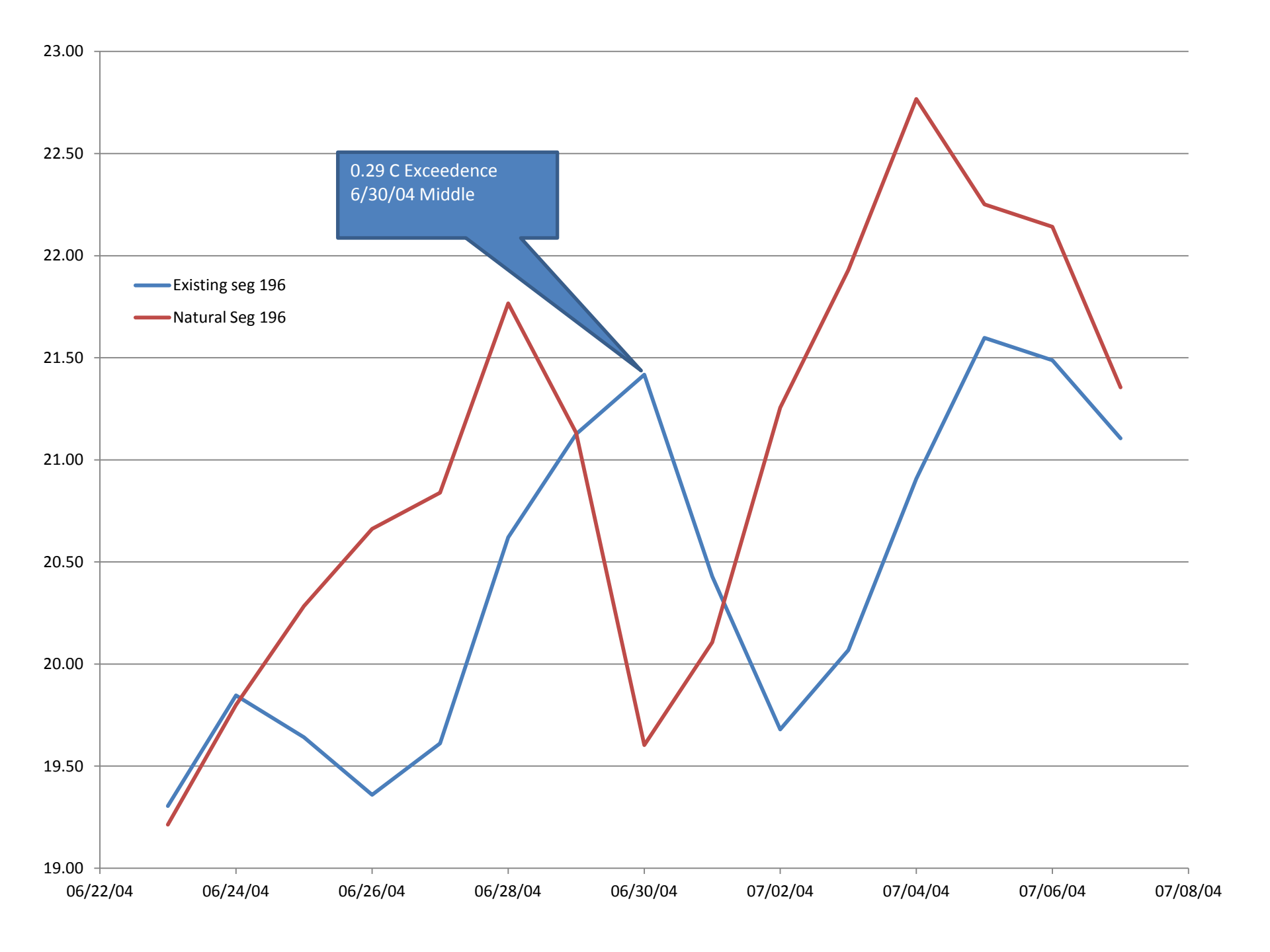
Weather Data

- Evidence from all climate stations used in model shows 90% cloud cover, high precipitation and unusually cool conditions between August 22 and 29, 2004, when half of the exceedences occurred
- Deer Park, Newport, Felts Field, and Tacoma Creek stations show storm conditions on June 30, 2004
- Local stations show some rain fall on June 24, 2004


Sandpoint, ID, USA
Forecast: NOAA
Graphs
Forecast Daily 1 quarter 1 year Averages
History
Major Storm and unusually cool conditions
Clouds
100%
50%
0%
Precip. Amount
0.020"
0.000"
0.000" Median
0.000"
Temperature
90°F
80°F
70°F
60°F
50°F
40°F
30°F
20°F
88°F High
82°F High
91°F High
93°F High
91°F High
83°F Mean High
54°F Low
37°F Min Low
43°F Low
52°F Mean Low
52°F Low
48°F Low
48°F Low
55°F Low
36°F Min Low
Freezing
Wind Speed
30.0 mph
20.0 mph
10.0 mph
0.0 mph
8.1 mph
6.9 mph
7.6 mph
8.5 mph
5.4 mph
6.7 mph
6.5 mph
Wind
Jun 20 2004
Jun 27 2004
Jul 4 2004
Jul 11 2004
Jul 18 2004
Jul 25 2004
Aug 1 2004
Aug 8 2004
Aug 15 2004
Aug 22 2004
Aug 29 2004

Graphs of Data Show Time Lag

6 out of the 8 instances where the max daily criterion applies and that exceed the Box Canyon LA show a time lag effect when plotted


23.00
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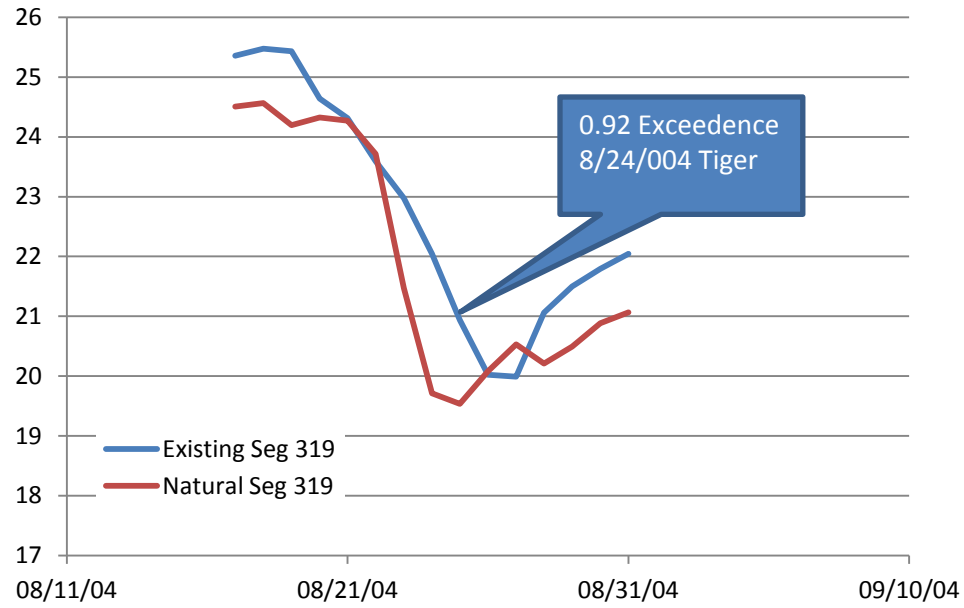
22.00
21.50
21.00
20.50
20.00
19.50
19.00
06/22/04
06/24/04
06/26/04
06/28/04
06/30/04
07/02/04
07/04/04
07/06/04
07/08/04
0.29 C Exceedence
6/30/04 Middle
Existing seg 196
Natural Seg 196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19
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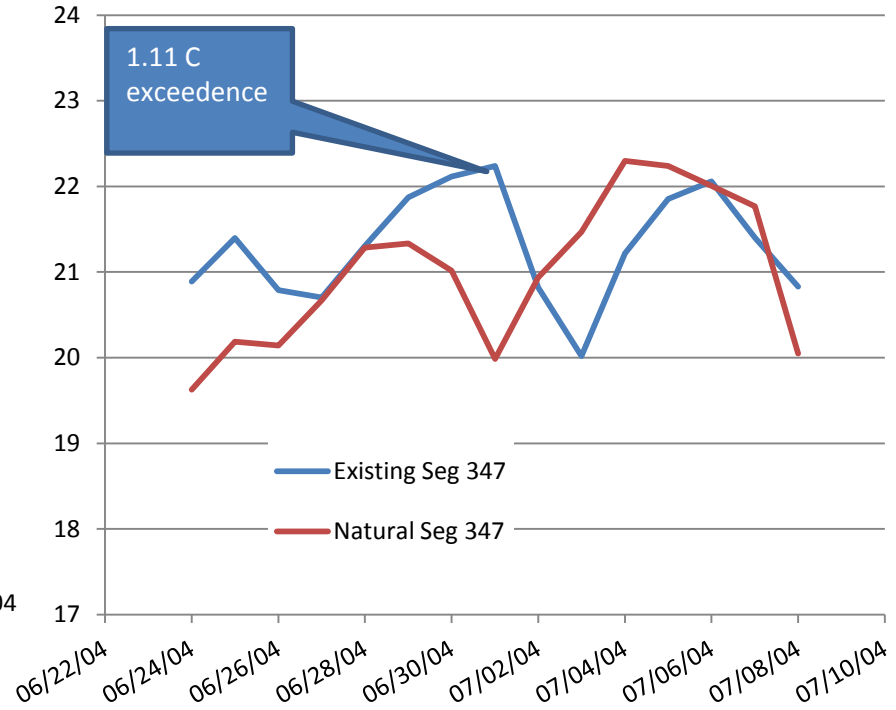
17
08/11/04
08/21/04
08/31/04
09/10/04
0.92 Exceedence
8/24/004 Tiger
Existing Seg 319
Natural Seg 319


24
23
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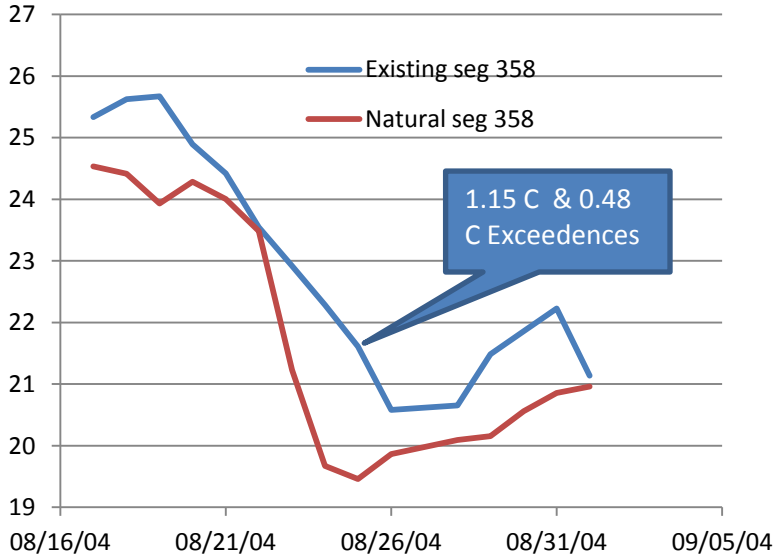
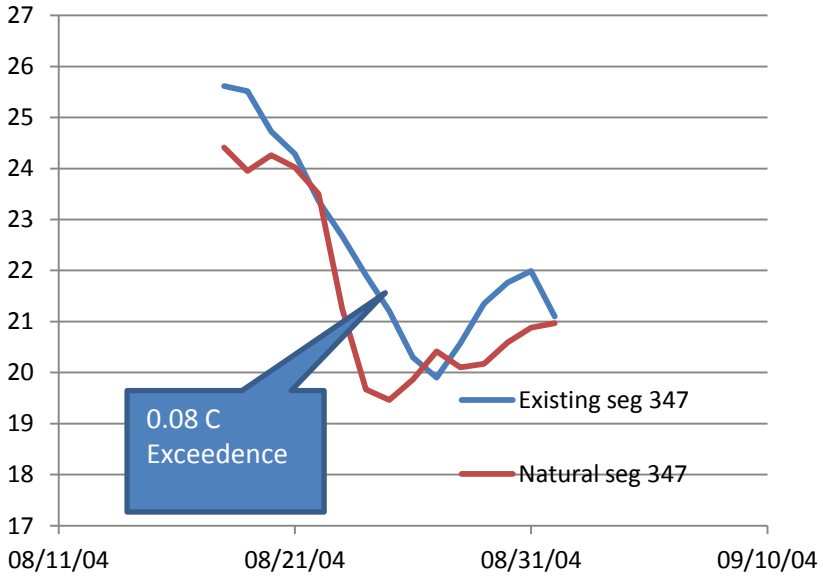
18
17
06/22/04
06/24/04
06/26/04
06/28/04
06/30/04
07/02/04
07/04/04
07/06/04
07/08/04
07/10/04
1.11 C
exceedence
Existing Seg 347
Natural Seg 347


27
26
25
24
23
22
21
20
19
08/16/04
08/21/04
08/26/04
08/31/04
09/05/04
Existing seg 358
Natural seg 358
1.15 C & 0.48
C Exceedences


27
26
25
24
23
22
21
20
19
18
17
08/11/04
08/21/04
08/31/04
09/10/04
0.08 C
Exceedence
Existing seg 347
Natural seg 347

Human or Natural Causes?

Though it is not possible to explicitly link the model temperature fluctuations to causes, indications of natural origin of exceedences include:

- Sharp increases in stream flow immediately after the exceedences that would have arrived earlier in the undammed simulation
- No evidence linking these exceedences to dam operations (lack of persistent trends)
- Plots of model data show evidence of time lag
- Cool weather, wind and precipitation precede exceedences

Kalispel Daily Maximum Criteria

- 1) Temperature shall not exceed 18°C as a moving 7-day average of the daily maximum temperatures with no single daily maximum temperature greater than 20.5°C.
- When natural background conditions prevent the attainment of the numeric temperature criteria, human-caused conditions and activities considered cumulatively can increase temperature levels by only an additional 0.3°C.
- 12 b (1) Kalispel Tribal Water Quality Standards

Kalispel 20.5 C Daily Maximum Criteria

- The TMDL looked at segments 115 and 172, upstream and downstream of Kalispel Tribal waters to assess how to meet the Tribe's WQS and called for a 0.27 C reduction in this area
- Using Daily Comparison the 20.5 C maximum was exceeded 224 times in these segments over the two years
- In 8 of these instances the natural conditions simulation was lower than 20.5 C so the daily maximum criteria applied

20 C Criteria Exceedences

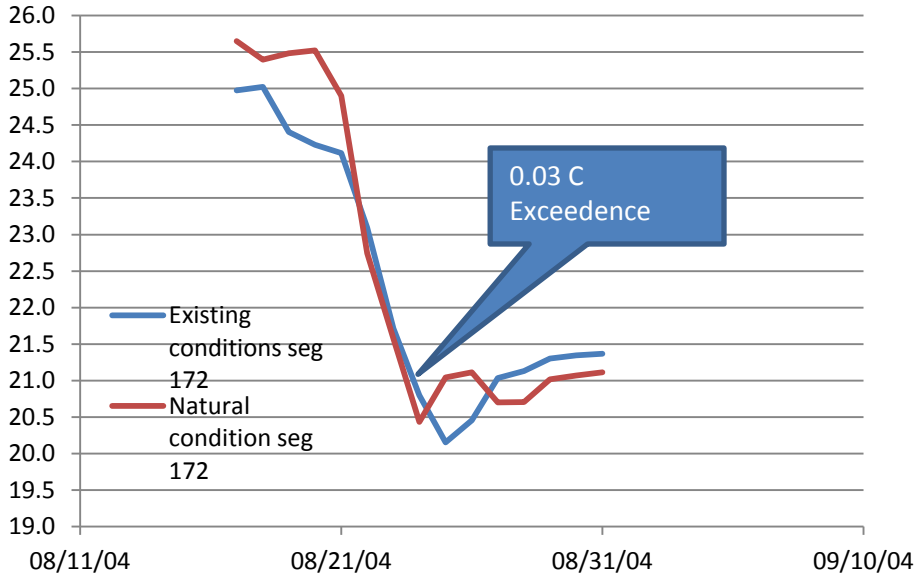
- For those 8 instances where the 20.5 C D-Max criteria was exceeded:
  - None of the exceedences were greater than the 1.13 C LA for Box Canyon Dam
  - Five exceeded the 0.27 C reduction the TMDL calls for at the Kalispel border.
  - The average exceedence over the called for reduction was 0.34 C; the maximum exceedence was 0.56 C

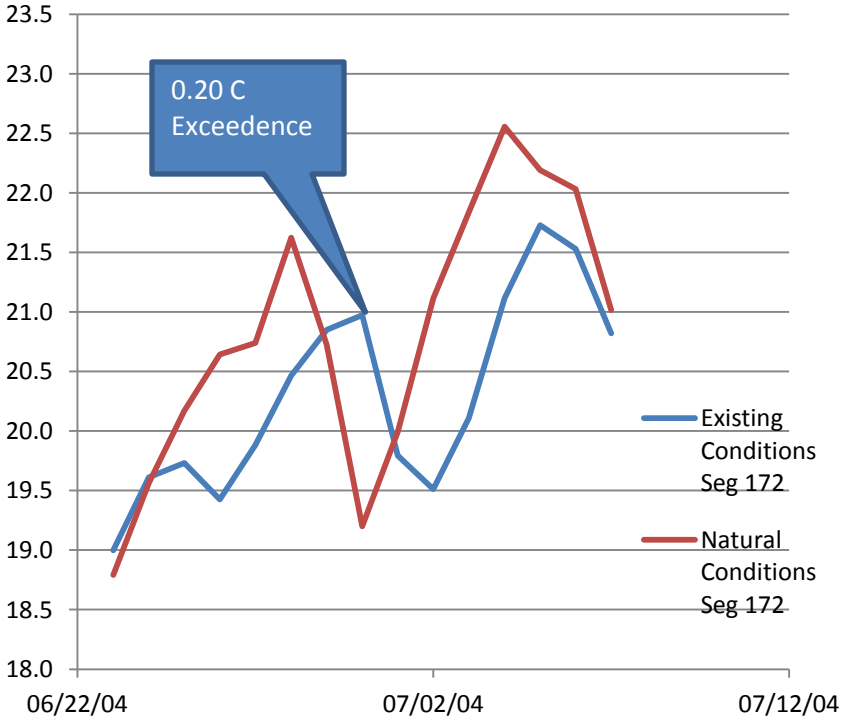
Natural Conditions

- The Kalispel Standards also contain a clause acknowledging that natural conditions may cause exceedences of the numeric criterion
- The exceedences at the Kalispel boundary occur on dates (8/24/04 – 8/29/04 & 6/30/04) that have been discussed above as having evidence of flow and weather conditions associated with time lag
- Plots of the data also show time lag effects

Kalispel Daily Maximum Criteria

- 1) Temperature shall not exceed 18°C as a moving 7-day average of the daily maximum temperatures with no single daily maximum temperature greater than 20.5°C.
- When natural background conditions prevent the attainment of the numeric temperature criteria, human-caused conditions and activities considered cumulatively can increase temperature levels by only an additional 0.3°C.
- 12 b (1) Kalispel Tribal Water Quality Standards


26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
0.03 C Exceedence
Existing conditions seg 172
Natural condition seg 172
08/11/04
08/21/04
08/31/04
09/10/04


23.5
23.0
22.5
22.0
21.5
21.0
20.5
20.0
19.5
19.0
18.5
18.0
0.20 C Exceedence
Existing Conditions Seg 172
Natural Conditions Seg 172
06/22/04
07/02/04
07/12/04

Summary of Evidence that Exceedences Are Caused by Natural Effects					
Date	**Segment**	**Degrees C Over Load Allocation/ Reduction**	**Plots Show Time Lag**	**Flow Data**	**Local Weather Data**
6/24/04	357	0.20		X	Fair
6/24/04	332	0.17		X	Fair
6/30/04	196	0.29	X		Strong
7/1/04	347	1.11	X		Strong
8/24/04	358	1.15	X	X	Strong
8/24/04	316 – 319	0.92	X	X	Strong
8/25/04	358	0.48	X	X	Strong
8/25/04	347	0.08	X	X	Strong
6/30/04	172	0.18	X		Strong
8/24/04	172	0.01	X	X	Strong
8/27/04	115	0.54		X	Strong
8/28/04	115	0.43		X	Strong
8/29/04	115	0.45		X	Strong

Human Use Allowance Issue

- Because the TMDL aggregates all the data that exceeded the daily maximum and treated these as though they were exceedences of the natural conditions criteria, applying the 0.3 human use allowance to them, the daily maximum criteria has not been addressed.
- **The daily maximum criteria apply in 3.5% of the instances where the numeric criteria are exceeded, using the Daily Comparison method**
- **In an even smaller sub set of these instances the allocations and reductions set in the TMDL do not bring about attainment of the standard**
- **Those instances show strong evidence of time lag effects due to natural conditions, which would exempt them from the daily maximum criteria**
- **The tribe is arguing that ANY increase in temperature when the natural temperature is equal to 20.5 deg C is not allowable. We do not think this is a reasonable or practicable reading of a standard that allows a 0.3 deg C increase when biological thresholds are exceeded due to natural conditions. Based on the tribe's interpretation, if the temperature was hypothetically 20.49999, then a 0.00001 deg C increase by a source would be considered a violation. Not practical or reasonable.**

Stateline Temperature Loading

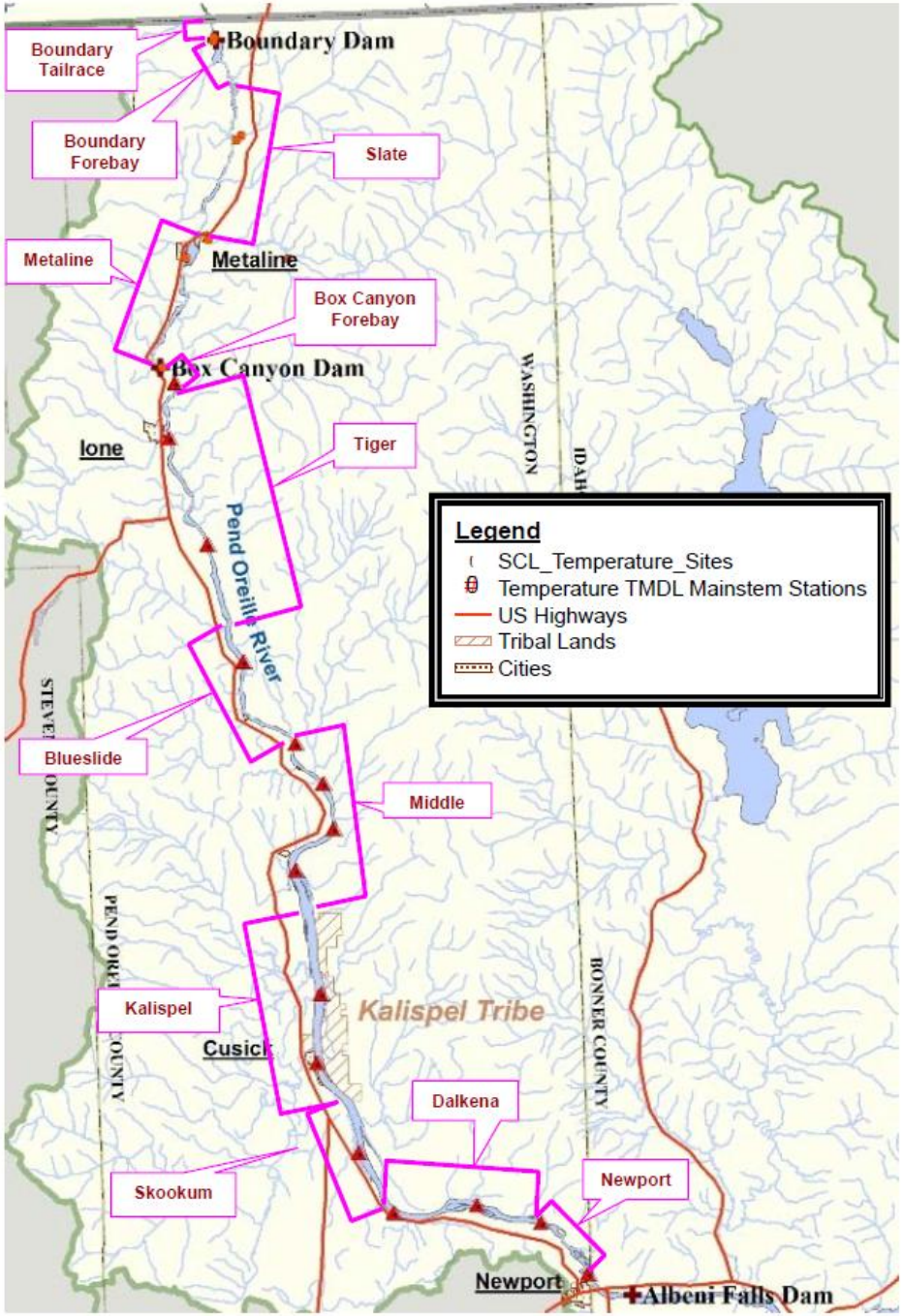
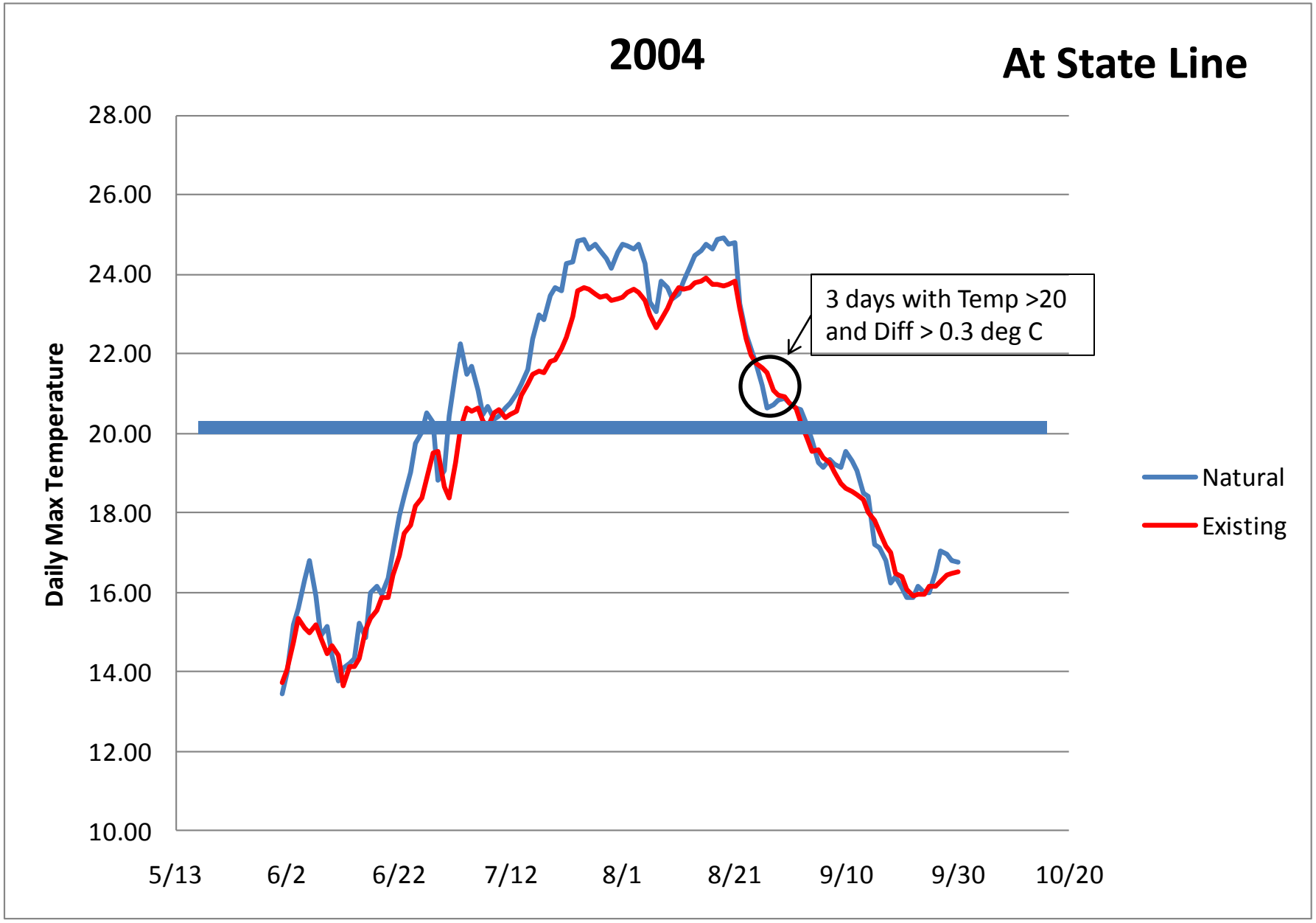
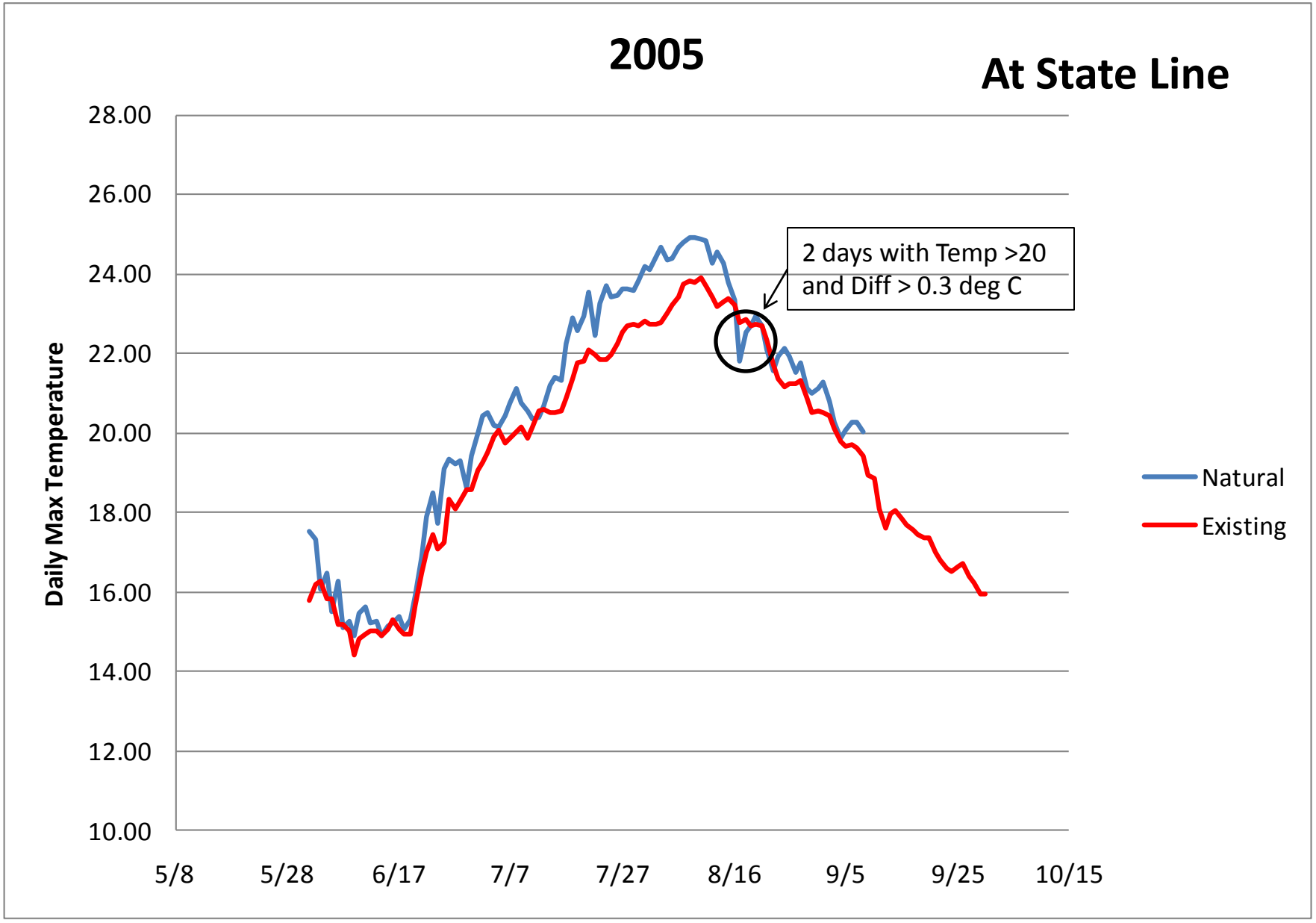


Figure 7. Pend Oreille River reaches and monitoring locations.


2004
At State Line
Daily Max Temperature
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
5/13
6/2
6/22
7/12
8/1
8/21
9/10
9/30
10/20
3 days with Temp >20
and Diff > 0.3 deg C
Natural
Existing


2005
At State Line
Daily Max Temperature
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
5/8
5/28
6/17
7/7
7/27
8/16
9/5
9/25
10/15
2 days with Temp >20
and Diff > 0.3 deg C
Natural
Existing

Albeni Falls Dam

- Kalispel Tribe makes two assertions

(1) State line is impaired based on the “correct” analytical method

(2) On days when tribal standards are exceeded (downstream of border in tribal waters), Albeni is contributing heat to the river.

  - Therefore, Albeni should be assigned a TMDL allocation

Issue 1: Region 10 Analysis of State Line

- Notes
  - River at border is WA state waters
    - One source in ID – Albeni Falls dam – removed in natural conditions model simulation
    - This changes geometry, depth, travel time, flow and temperature
  - Multiple slicing/dicing of the model output
    - Seasonal CFA and multiple point-by-point (daily) methods
  - Focused on daily max state standard (20 deg C)
    - July/August is period with temps > 20 deg C
    - Model output is max from water column
      - typically surface temperatures
      - we have not looked at potential volume averaging effects

Time series model output

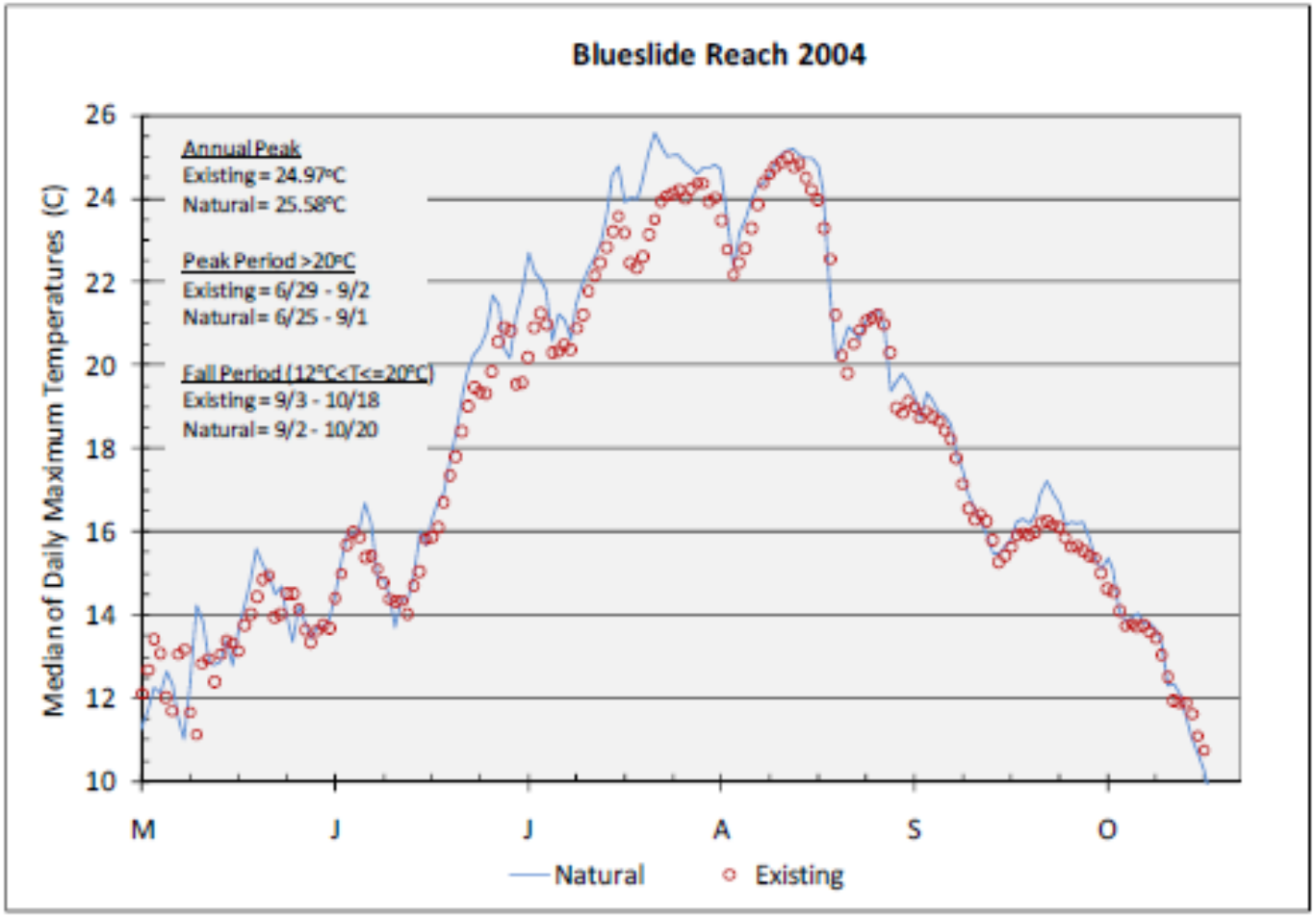
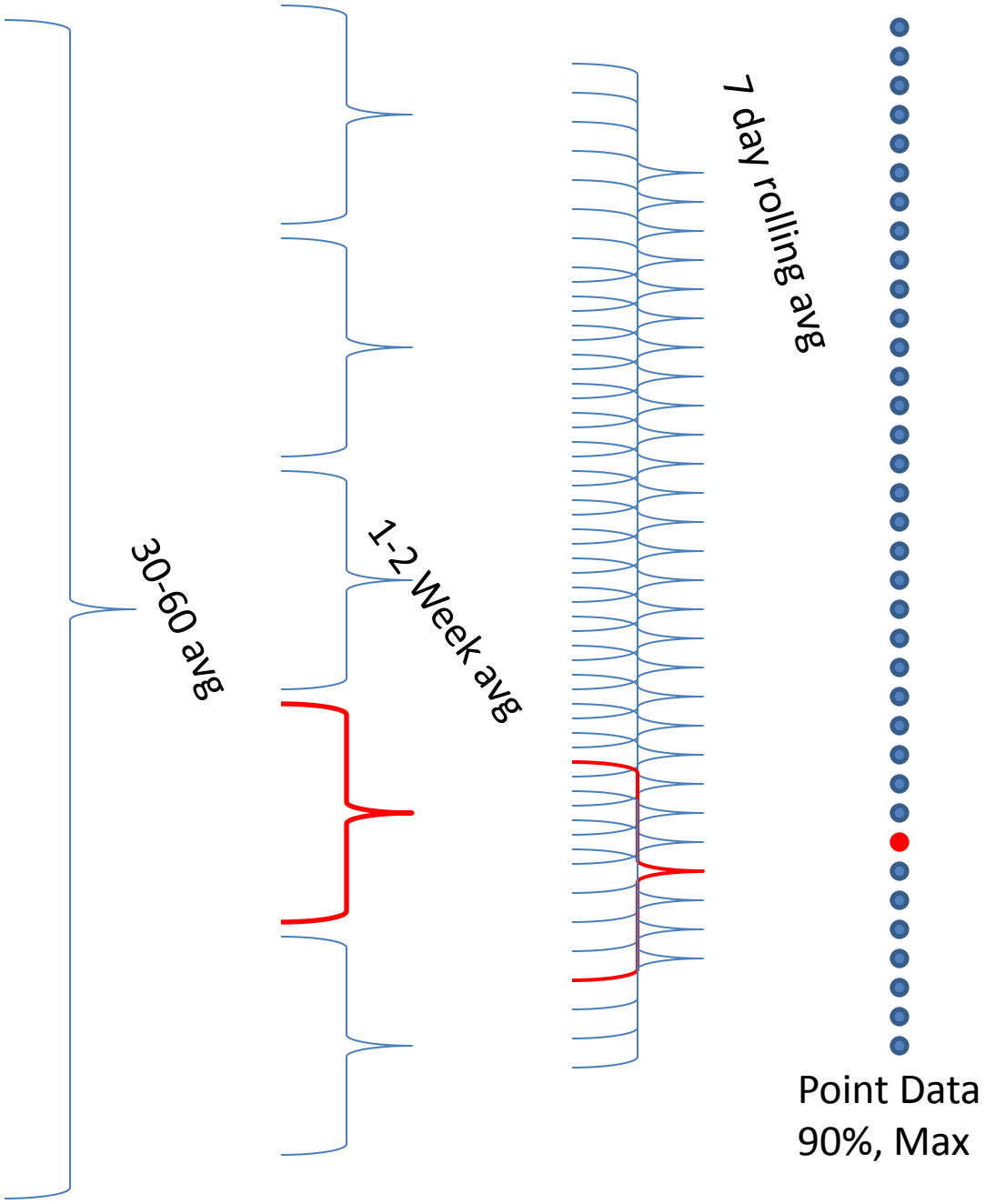


Figure 8. Modeled natural and existing median daily maximum temperatures for the Blueslide reach in 2004.

Date	Natural	Existing	Diff
06/30/05	19.41	18.58	-0.83
07/01/05	19.98	19.07	-0.91
07/02/05	20.43	19.27	-1.17
07/03/05	20.51	19.52	-0.99
07/04/05	20.19	19.90	-0.29
07/05/05	20.16	20.05	-0.10
07/06/05	20.43	19.75	-0.69
07/07/05	20.76	19.87	-0.89
07/08/05	21.11	20.03	-1.09
07/09/05	20.74	20.13	-0.60
07/10/05			0.68
07/11/05			0.20
07/12/05	20.39	20.55	0.16
07/13/05	20.69	20.58	-0.11
07/14/05	21.19	20.52	-0.67
07/15/05	21.39	20.53	-0.86
07/16/05	21.31	20.57	-0.74
07/17/05	22.25	20.88	-1.38
07/18/05	22.90	21.37	-1.52
07/19/05	22.59	21.78	-0.81
07/20/05	22.96	21.80	-1.16
07/21/05	23.52	22.08	-1.45
07/22/05	22.44	21.95	-0.49
07/23/05	23.28	21.83	-1.45
07/24/05	23.71	21.85	-1.86
07/25/05	23.43	21.97	-1.47
07/26/05	23.46	22.26	-1.20
07/27/05	23.64	22.52	-1.12
07/28/05	23.62	22.69	-0.93
07/29/05	23.60	22.72	-0.88

PAIRED ANALYSIS



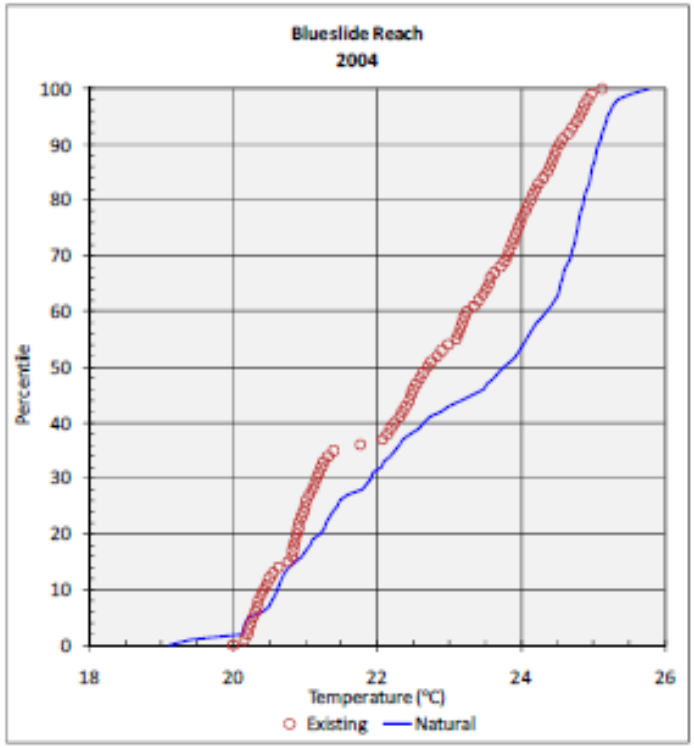
Lowest temp

Rank	Natural	Existing	Diff
1	19.41	18.58	-0.83
2	19.98	19.07	-0.91
3	20.16	20.05	-0.10
4	20.19	19.90	-0.29
5	20.37	20.17	-0.20
6	20.39	20.55	0.16
7	20.43	19.75	-0.69
8	20.43	19.27	-1.17
9	20.51	19.52	-0.99
10	20.55	19.87	-0.68
11			-0.11
12			-0.60
13			-0.89
14	21.11	20.03	-1.09
15	21.19	20.52	-0.67
16	21.31	20.57	-0.74
17	21.39	20.53	-0.86
18	22.25	20.88	-1.38
19	22.44	21.95	-0.49
20	22.59	21.78	-0.81
21	22.90	21.37	-1.52
22	22.96	21.80	-1.16
23	23.28	21.83	-1.45
24	23.43	21.97	-1.47
25	23.46	22.26	-1.20
26	23.52	22.08	-1.45
27	23.60	22.72	-0.88
28	23.62	22.69	-0.93
29	23.64	22.52	-1.12
30	23.71	21.85	-1.86
31	23.83	22.71	-1.12
32	24.09	22.74	-1.35
33	24.20	22.82	-1.39

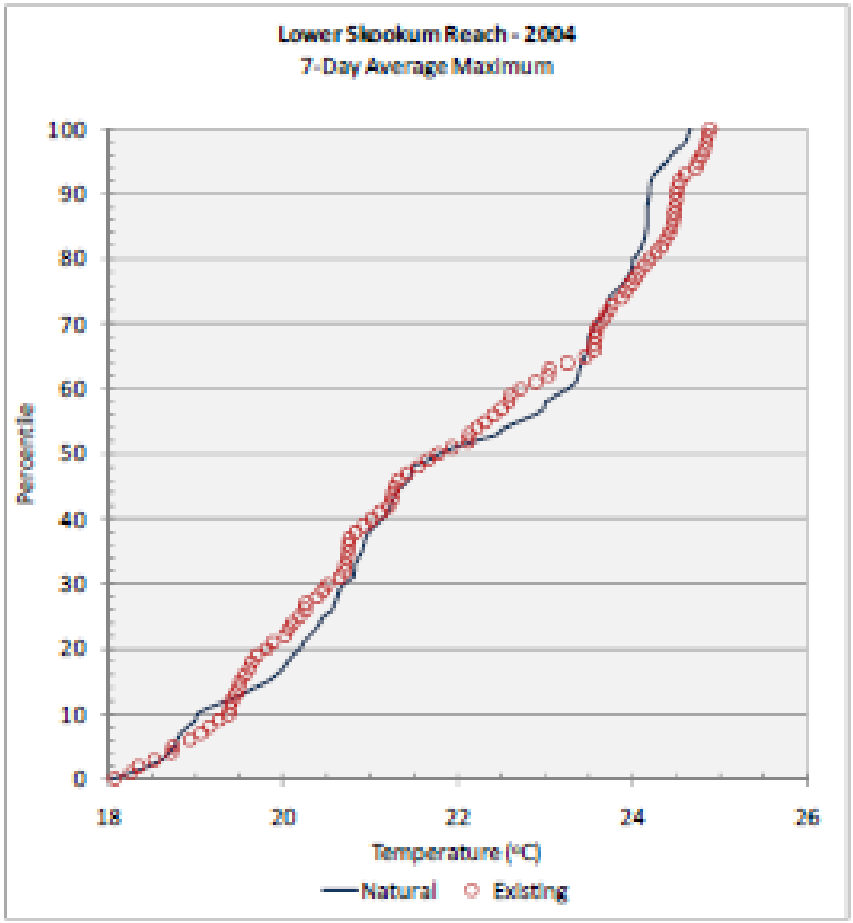
Highest temp

CFA ANALYSIS

TMDL uses maximum difference for all ranked pairs



CFA plots



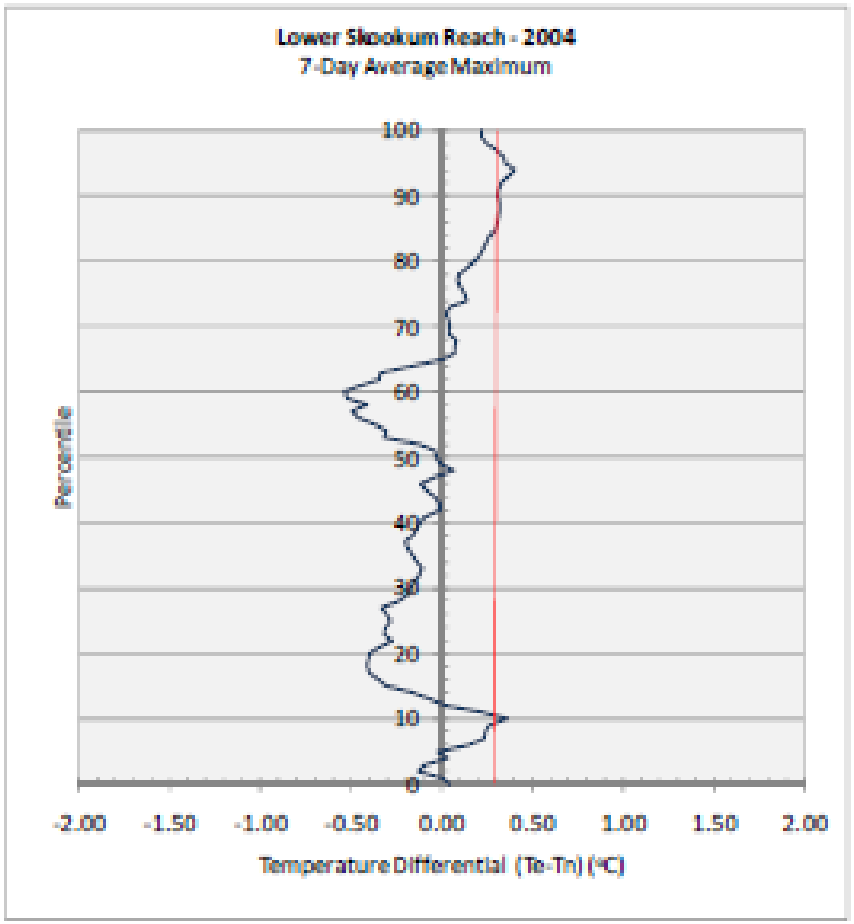
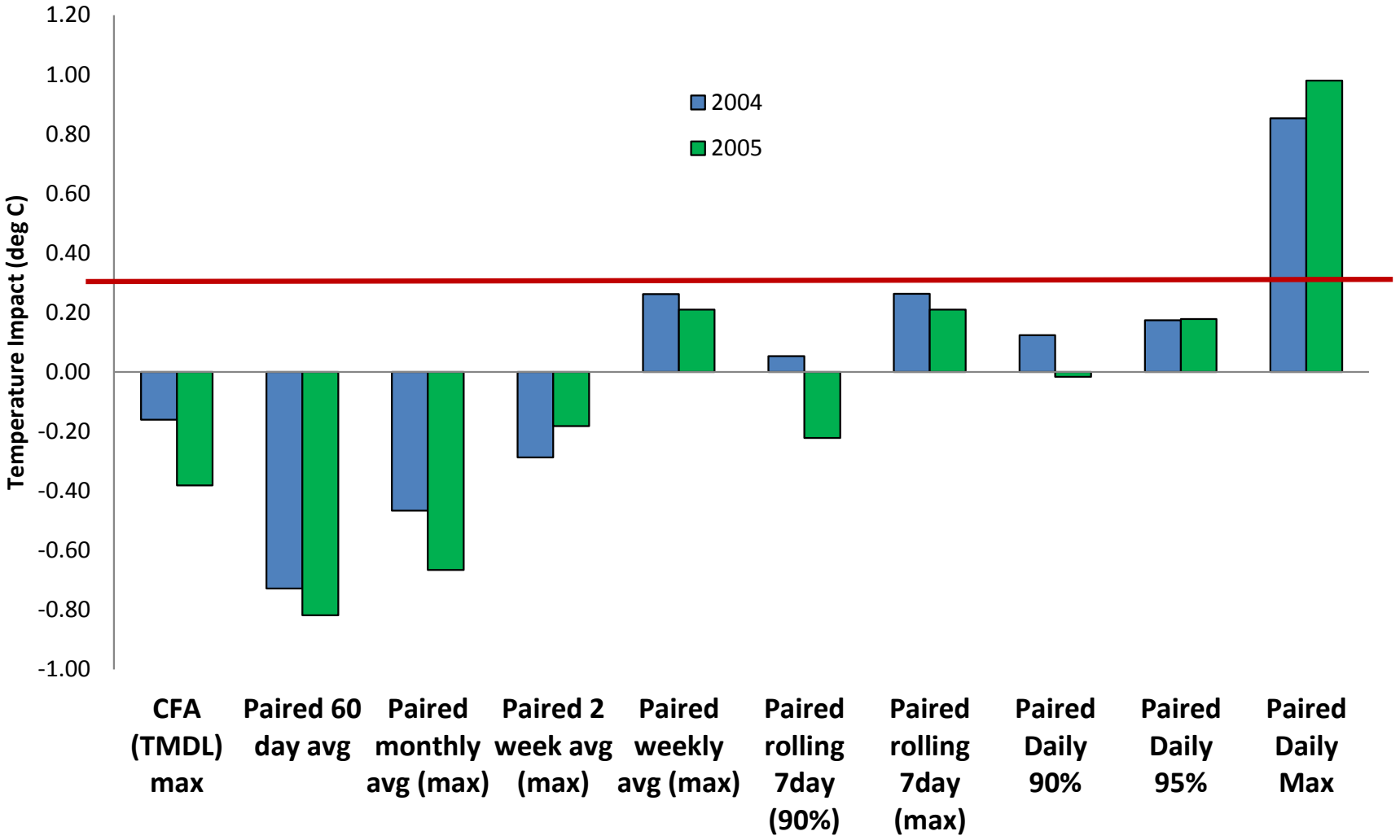


Figure 20. Segment 115 cumulative frequency distribution of the 7-day average of the daily maximum temperatures along with the associated temperature differential. *Analysis includes the natural and existing conditions observed at lower Skookum reach (segment 115) in 2004.*

2004 and 2005 Model Output Analyses
State Line, July/August



State of Washington Impairment Call

- State discretion
- For direct measurements, 90th percentile is common for 303d listing
- In PdO case, all methods, including paired 90th percentile, show impacts less than the 0.3 deg C limit
- One exception: Paired maximum value
- Weak basis to overrule state decision

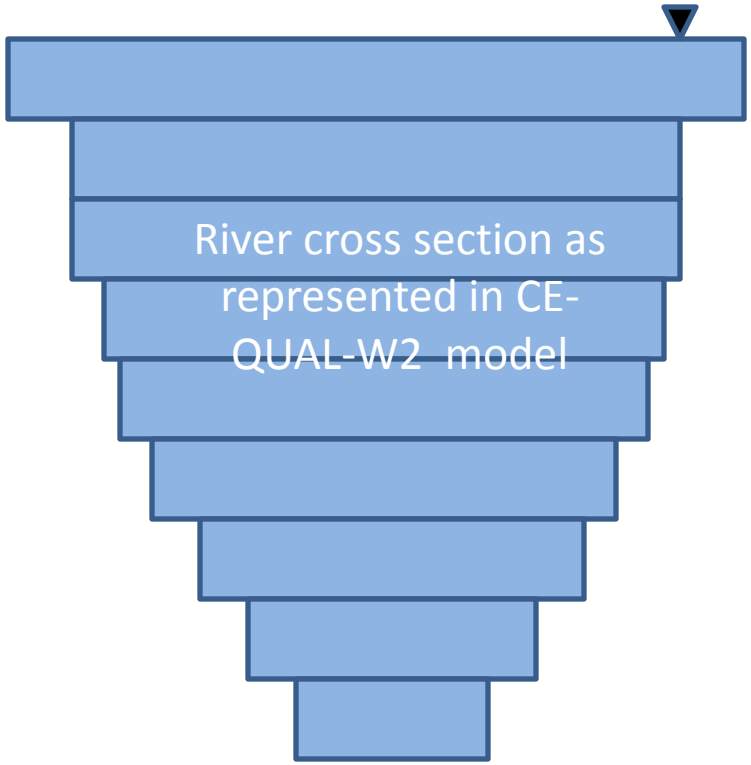
Issue 2: Albeni heat contribution warrants an allocation

- On almost all days, Albeni sends colder-than-natural water across the border
- Box Canyon dam forebay temps are generally warmer-than-natural
- TMDL allocation is difference at Box forebay caused by presence of both dams.
  - TMDL allocated temp difference from both dams to Box Canyon
- Box Canyon did not object
- TMDL allocations are mathematically sound
  - Issue is only who is responsible for impacts in Box Canyon impoundment
  - State assigns allocation to Box Canyon PUD.

Volume Averaging

Sum of (cell temp x cell volume)/(total volume) = volume-weighted average temperature

24.0	x
23.8	x
23.5	x
23.1	x
22.9	x
22.5	x
22.1	x
21.7	x
21.5	x



- Surface cell has greater volume than bottom, represents more habitat
- Volume-averaging used to get a single value that best represents water column as a whole
- Changes magnitude of estimated impairment

Exceedences found on Reservation Borders using Daily Comparison

- The Tribe found 37 days of exceeedences at the reservation borders in 2004, averaging 0.35 C and with maximum of 0.87 C above the Tribe's criteria
- Our review of data using Daily Comparison could not replicate the tribe's but found exceedences at the reservation boundary above the called for TMDL reductions on 25 days for the entire 2 year period modeled
- The exceedences ranged from 0.54 C to 0.01 C above the TMDL reductions and averaged 0.24 C, which is similar to the Tribe's results
- The Tribe did not mention that the TMDL does acknowledge impairment to Tribal waters and sets reductions to meet the Tribe's WQS

Daily Comparison Analysis Exceedences at Borders of Kalispel Reservation Above the TMDL Reduction

Date	Existing Conditions Temperature	Natural Conditions Temperature	Degrees over Called for Reduction	Location	Criteria
06/30/04	20.97	19.20	0.18	RM 64 Upstream Reservation Border	20.5 C Daliy Max.
08/24/04	20.80	20.43	0.01	RM 64 Upstream Reservation Border	20.5 C Daliy Max.
08/27/04	21.33	20.49	0.54	RM 72 Downstream Reservation Border	20.5 C Daliy Max.
08/28/04	21.22	20.14	0.43	RM 72 Downstream Reservation Border	20.5 C Daliy Max.
08/29/04	21.24	20.20	0.45	RM 72 Downstream Reservation Border	20.5 C Daliy Max.
07/30/04	24.50	23.62	0.29	RM 72 Downstream Reservation Border	Natural Conditions
08/11/04	24.56	23.57	0.40	RM 72 Downstream Reservation Border	Natural Conditions
08/30/04	21.23	20.51	0.13	RM 72 Downstream Reservation Border	Natural Conditions
07/28/05	24.10	23.48	0.04	RM 72 Downstream Reservation Border	Natural Conditions
08/18/05	23.12	22.09	0.44	RM 72 Downstream Reservation Border	Natural Conditions
08/19/05	23.08	22.27	0.22	RM 72 Downstream Reservation Border	Natural Conditions
08/20/05	23.38	22.46	0.33	RM 72 Downstream Reservation Border	Natural Conditions
08/22/05	23.37	22.55	0.23	RM 72 Downstream Reservation Border	Natural Conditions
08/23/05	22.40	21.65	0.16	RM 72 Downstream Reservation Border	Natural Conditions
08/24/05	21.90	21.02	0.29	RM 72 Downstream Reservation Border	Natural Conditions
08/14/04	24.75	24.16	0.05	RM 72 Downstream Reservation Border	18 C 7-DADM
09/08/04	19.50	18.84	0.11	RM 72 Downstream Reservation Border	18 C 7-DADM
09/09/04	19.40	18.80	0.07	RM 72 Downstream Reservation Border	18 C 7-DADM
08/20/05	23.26	22.57	0.15	RM 72 Downstream Reservation Border	18 C 7-DADM
08/21/05	23.09	22.32	0.23	RM 72 Downstream Reservation Border	18 C 7-DADM
08/22/05	22.97	22.16	0.27	RM 72 Downstream Reservation Border	18 C 7-DADM
08/23/05	22.79	22.08	0.17	RM 72 Downstream Reservation Border	18 C 7-DADM
08/24/05	22.62	21.99	0.09	RM 72 Downstream Reservation Border	18 C 7-DADM

Daily Comparison Exceedences of Tribe's WQS vs TMDL Determination

	Above the Kalispel Reservation (RM 72, Segment 115)		Below the Kalispel Reservation (RM 63.6, Segment 172)	
Criteria	**Average differential**	**Maximum differential**	**Average differential**	**Maximum differential**
Kalispel daily maximum	0.06	0.60	-0.50	0.22
Kalispel 7DADM	-0.03	0.40	-0.51	0.14

"CFA underestimates the magnitude of the maximum temperature violation by a factor of approximately 1.5 (0.6 degrees versus 0.9 degrees)"

- **This table is similar to one in the TMDL. The maximum differential value is equal to the sum of the human use allowance (0.3 C) and the reductions specified in the TMDL (0.29 C for the daily maximum criterion and 0.24 C for the 7DADM criterion). The issue is that the CFA method is slightly less stringent than the tribe's preferred method.**
- **The tribe's preferred method would set the two month allocation (July-August) at the maximum impact in the paired data of 0.9 deg C – one that was estimated by the model to occur on a single hour of a single day.**
- **Note that Ecology did not use the mean difference and opted for the more conservative CFA maximum difference. Ecology could have considered vertically averaging the impoundment temperatures. This would have reduced the allocations substantially.**
- **Note that the average differential is minimal or even negative, meaning that, but for 3 days of unknown river dynamics, the river is generally colder with the dams in place than without at these locations – this particularly true at the upstream border near the Idaho line – which the Tribe's version of this table calls "Below the Kalispel Reservation"**

Impairment of Tribal Waters from Upstream Sources - Stateline

- "Violations occur on 87% of the days during the period from 8/9/04 to 9/1/04; on 85% of these days, heat flow across Stateline is greater under existing conditions than it was under natural conditions"
- **Our analysis of the data does not confirm these assertions**
  - **Using Daily Comparison, exceedences above the reductions in the TMDL occur on 11 days out of the 24 day period mentioned – 46%. All but two of these were at the downstream border of the reservation nearer to Box Canyon Dam, which received a substantial allocation and was called on to reduce temperatures at the reservation boundary as well**
  - **During this time there are 4 days of exceedences (using Daily Comparison) at the state line – 17%. These are the only exceedences at the stateline in 2004 and they occur during the major storm that was discussed above as a cause of time lag effects**

Does the TMDL Adequately Assess for Attainment of Kalispel WQS?

- "Incorrect application of Kalispel temperature criteria"; "Failure to identify the proper frequency and magnitude of Kalispel temperature violations"
- **This apparently refers to Ecology's choice of CFA rather than the Tribe's preferred Daily Comparison approach. There are multiple reasonable interpretation, data analysis methods and in this instance the state has discretion to choose. Nothing in the Kalispel WQS wording requires use of Daily Comparison**

- "Failure to account for upstream heating contributing to violations of Kalispel temperature criteria"
- **As our earlier discussion shows, there is no evidence of exceedence upstream at the stateline, water there is almost always cooler under existing conditions than under natural and, where the Daily Comparison method shows 4 days of exceedence at the stateline, this appears to be the result of a time lag effect.**
-
- "Resulting allocations will intensify the temperature problem within Kalispel waters"
- **Is the tribe suggesting that the TMDL, which puts responsibilities on the dams to reduce temperatures, will make current conditions worse? How?**

Ecology's Justifications for Using CFA Have No Rational Basis

- "We don't have to comply with our own water quality standards"
  - "There are many parts of [state water quality] standards that we choose not to implement in TMDLs." (Internal email from Susan Braley, Dep't of Ecology (July 25, 2008)
  - "The special condition in Table 602 for the Pend Oreille is established as a 1-day maximum because that is what the standards metric was before we revised our water quality standards in 2003. We made a deliberate decision not to change any of the special conditions because they hadn't been earmarked as part of our proposed revisions. . . . [I]n the last 303(d) listing process we assessed temperature data based on the 7DADMax even though the standards were set as one day maxs. So, my recommendation was that we use the seven day metric for the Pend Oreille for the modeling exercise . . . ." (Braley email, Nov. 30, 2007)"
  - **If 5 year old internal emails at Ecology, are a concern we can discuss and provide context. Overall, this has been a very complex issue with many discussions of options and alternatives. What matters is the final product, i.e. the TMDL submitted for approval**.

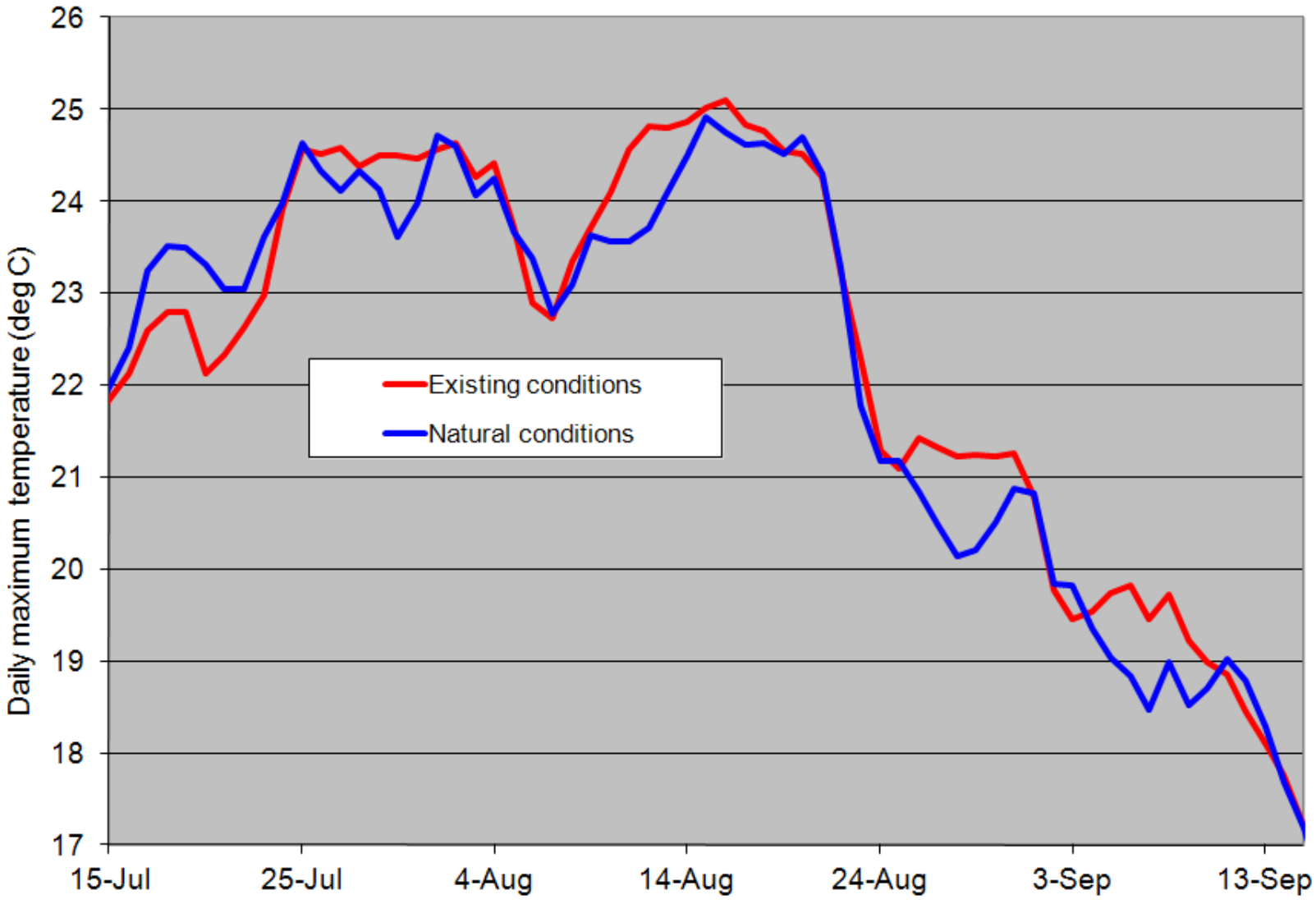
Ecology's Justifications for Using CFA Have No Rational Basis

- "The Willamette TMDL used CFA so we can use it here"
  - "EPA advised Ecology to look to the Willamette TMDL for support to beef up its rationale for using CFA"
  - "Ecology found no support"
  - "ODEQ confirmed that the Willamette TMDL did not provide a rationale for using CFA"
  - "Ecology did not look for support elsewhere, noting instead that ODEQ's statement that it "didn't do much to justify using the cfd . . . is priceless"
- **First bullet is accurate. We also encouraged Ecology to beef up its response to comments when this dispute arose.**
- **ODEQ did not need to build a detailed explanation of their use of CFA, because there were no comments on the method during the public process. The use of CFA was not controversial until the Tribe brought it up during this TMDL. Ecology described the method and reason for using CFA in the TMDL.**
- **Last bullet is misleading since there were no other examples of this kind of CFA analysis in the Region.**

No Rational Basis for Use of CFA

- "CFA is necessary to account for time lag"
  - "Next slide shows that there is no significant time lag"
- **The state has indicated that the time lag issues are more clear/problematic at the downstream end of the study area (at Boundary Dam, well downstream of this location).**
- **Despite this, our analysis described above has shown convincing evidence of time lag effects in these lower reaches as well.**
- **If the time lag issue is deemed to be a reasonable concern, then it's also reasonable (and probably necessary) for the state to apply the same method across the entire study area, including tribal waters.**

Comparison of temperatures under existing and natural conditions at the upstream end of the Kalispel Tribe's reservation (River Mile 72)



No Rational Basis for Use of CFA

- "CFA is necessary to account for time lag"
  - "Next slide shows that there is no significant time lag"
- **Reducing time lag effects was not the only reason for using CFA**
- **Other reasons Ecology gave for use of CFA:**
- **Allows for the comparison of different hydrologic conditions by minimizing differences in volume and flow as a result of hydroelectric facility operation or land use changes**
- **Provides a way to determine how often temperatures of a given magnitude occur within a specific amount of time**

It also helps account for model uncertainty

CFA Pooling Period Issue

"Even if time lag were an issue, the pooling period does not correspond to the lag"

- "The selected remedy for the lag (93-day CFA) is grossly disproportionate to a time lag that is on the order of days according to Ecology, and at most 1 day on tribal waters"

- **Note the pooling period in the TMDL is actually 62 days, the pooling period in the Willamette TMDL was 93 days**
- **Ecology has not claimed that the pooling period corresponds to the time lag. It encompasses the period when temperatures exceed numeric criteria.**

CFA Was Used for Non-Scientific Reasons

- "Ecology employed CFA for non-scientific reasons in contravention of the Clean Water Act's TMDL requirements (*Earth Island Inst. v. Hogarth*, 494 F.3d 757, 768 (9th Cir. 2007))"
- **The implication is that Ecology adopted CFA analysis to cater to the dam operators by reducing the allocations set for them in the TMDL**
- **Our review of the TMDL indicates that Ecology had a sound scientific rationale for adopting CFA**
- **The TMDL allocations are much more stringent than they might have been had Ecology used a more common analysis method such as volume weighted averaging or used a one dimensional model with Daily Comparison**
- **The Dam operators were dissatisfied enough with the allocations that they both requested dispute resolution and filed in court to sue Ecology over the TMDL**

Use of CFA Inconsistent with Decision Not to Use Other Analysis Method

- "Ecology's decision to use CFA is incongruous with its decision not to allow volume-weighted averaging"
  - "Ecology rejected the argument that daily maximum temperatures should be determined by volume-weighted averaging because '[u]sing an average may obscure the impacts of warmer surface waters by averaging with cooler deeper waters.'"
  - "It is not rational to interpret the standards to prohibit spatial manipulations that mask water quality violations, but to permit temporal manipulations that achieve the same effect."
- **Incongruous or balanced? Ecology had several choices to make on methodology. They adopted CFA (time-aggregation) but not spatial aggregation. CFA was chosen by Ecology precisely because it would reduce model uncertainty and time lag effects without masking the dam's impact, which volume weighted averaging would have done.**
- **This is the typical situation when a regulator disappoints stakeholders on all sides by striking a balance. It is rational to examine and select model-data processing methods that account for model uncertainty, water quality standards metrics, allocation challenges, and a myriad of policy considerations.**
- **Instead of characterizing the choices made by Ecology as "incongruous", the tribe could recognize that the state took a tough stance on this particular element of the analysis (volume averaging), and also used the maximum difference from the CFA rather than simply averaging the natural-existing differences over weeks/months.**
- **The decision to use only CFA refutes the tribe's assertions that Ecology was pro-industry on this project.**

Use of CFA Is Technically Flawed

- The Tribe Claims:
  - Fundamental principle for using CFA is that individual occurrences are random
  - Time-series data generated by the CEQUAL-W2 model is not random
  - Therefore it is inappropriate to use CFA with CEQUAL-W2 data
- Temperature data generated by CEQUAL-W2 is not independent & random
- CFA is discussed in the texts quoted by the Tribe primarily in regard to performing hypothesis tests used to evaluate whether an empirical CDF is consistent with a specific hypothesized distribution or to evaluate whether two empirical CDFs come from the same underlying distribution.
- TMDL's approach is not based on a hypothesis test and does not attempt to make statistically based conclusions regarding the similarity (or lack of agreement) between the data sets
- CFA is used in the TMDL solely for comparing excursions of the temperature criteria. This use of CFA is not invalidated by the presence of correlation in the series.

Use of CFA in TMDLs - An Incomplete List

- Willamette River Temperature TMDL, OR, 2006
- Florida Mercury TMDL, 2012
- Commonly used in bacteria TMDLs in many states including, CT, HI, ND, DE, NC, NJ, OR, AZ, TN, TX
- Stockton Deep Water Shipping Canal Dissolved Oxygen TMDL, CA, 2005
- Muddy Creek and the Yadkin River Turbidity TMDL, NC, 2011
- Upper Clinch Watershed pH TMDL, TN, 2009
- Potomac Estuary PCB TMDL, DC, 2007
- Lake Elsinore and Canyon Lake Nutrient TMDL, CA, 2005
- Buckhannon River pH and metals TMDL, WV, 2010
- Indian Creek, Southampton Creek Paxton Creek and Goose Creek and Sawmill Run Watersheds total phosphorus and sediment TMDLs, PA (Issued by EPA) 2008
- Ridenour Lake Metals TMDL, WV,

EPA Approval of the TMDL Arbitrary & Capricious?

The Tribe case rests on the following points:

- "CFA does not comport with the temporal requirements of Kalispel or State water quality standards, and is statistically indefensible"
- "CFA masks the frequency and magnitude of Kalispel water quality violations, as well as upstream contributions to those violations"
- "Ecology's justifications for employing CFA have no rational basis"
- **We have addressed each of these concerns in this presentation and found them lacking in substance or technical basis.**

Conclusion

- Region 10 believes approval is appropriate
- If that is not the agreed-upon direction, need to develop next steps with Tribe and consider outreach to Ecology and possibly other stakeholders
- Anticipate litigation either way
- Awaiting HQ feedback and guidance on these issues